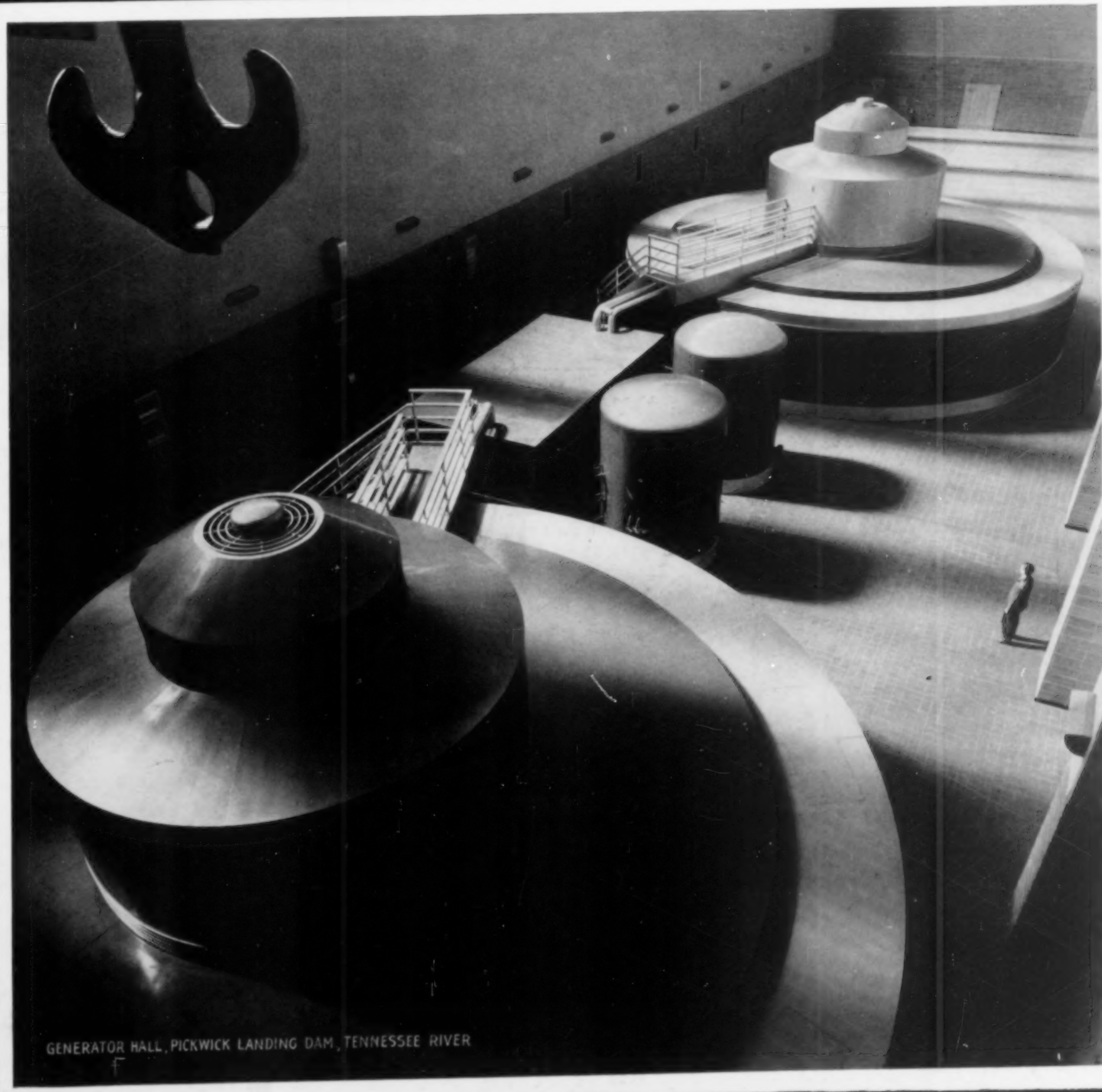
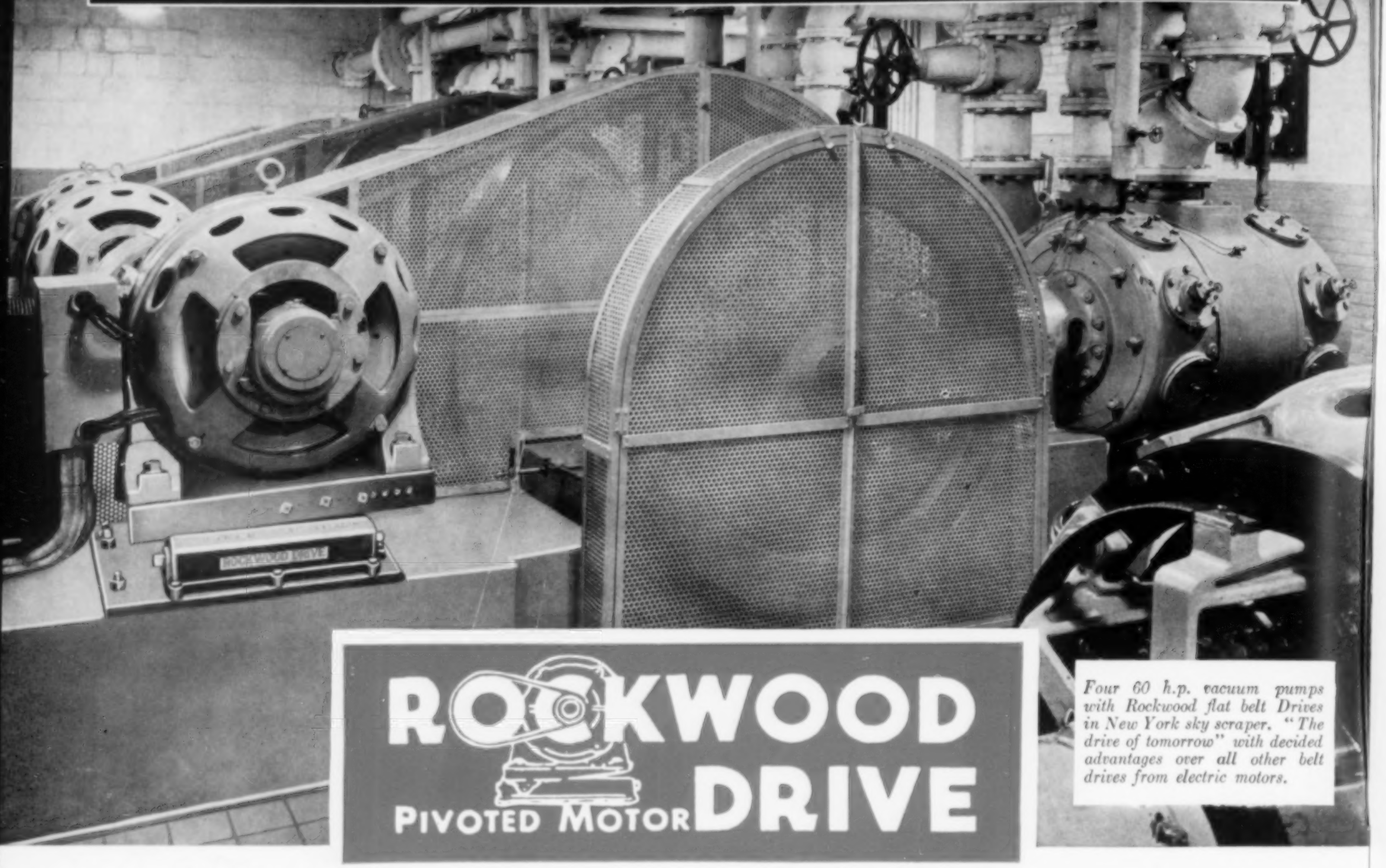
Compressed Air Magazine

Vol. 45, No. 5 London - New York - Paris May, 1940



GENERATOR HALL, PICKWICK LANDING DAM, TENNESSEE RIVER

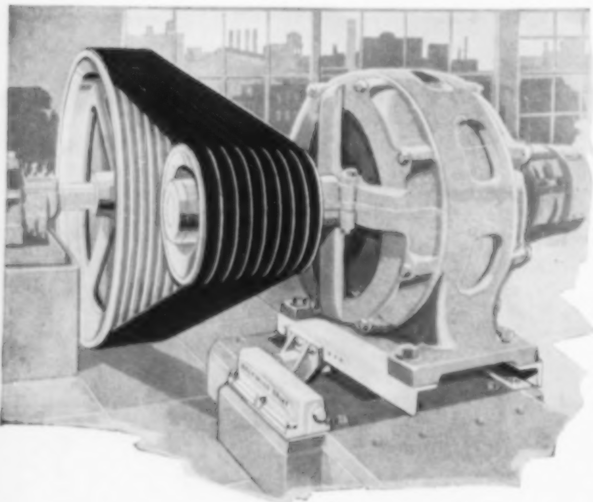
Rockwood Drives are reducing maintenance, saving power and improving performance on thousands of compressors



ROCKWOOD PIVOTED MOTOR DRIVE

*Four 60 h.p. vacuum pumps with Rockwood flat belt Drives in New York sky scraper. "The drive of tomorrow" with decided advantages over **all** other belt drives from electric motors.*

No belt-driven compressor can do its best work unless equipped with a Rockwood Pivoted-Motor Base



Use Rockwood Bases with your V-belt drives.

V-belts, too, do better work and last longer with Rockwood pivoted bases. V-belts are subject to the same "laws" as flat belts. They too, stretch in service. Then elongation causes them to slip—and to harden and glaze. When V-belts are used with Rockwood automatic tension control Bases, they often last twice as long. It costs but little to add a Rockwood Base to existing drives.

Few compressor users realize how belts stretch on fixed centers. Then they must be taken up manually. Meanwhile the slack belt affects the compressor performance and limits its capacity.

When belts stretch, compressor speeds fall off, the belts slip and may "burn" on the pulleys. Then the capacity of the compressor is lowered and power is wasted. With Rockwood pivoted-motor Bases—whether used with flat belts or V-belts—the belt tension is controlled, belt stretch *is taken care of as it occurs*, excessive belt slip is eliminated and power and belts are saved.

The reliability of the Rockwood Drive, its continuity of service and the saving in belt life have been repeatedly shown. Compressors are kept up to speed continuously—compressor performance is made more dependable—power costs are sharply reduced.

If you want maximum capacity from your compressor, with most satisfactory and dependable performance and lowest running cost it must be equipped with a Rockwood pivoted-motor drive. Usually you will more than pay for the change out of the first year savings.

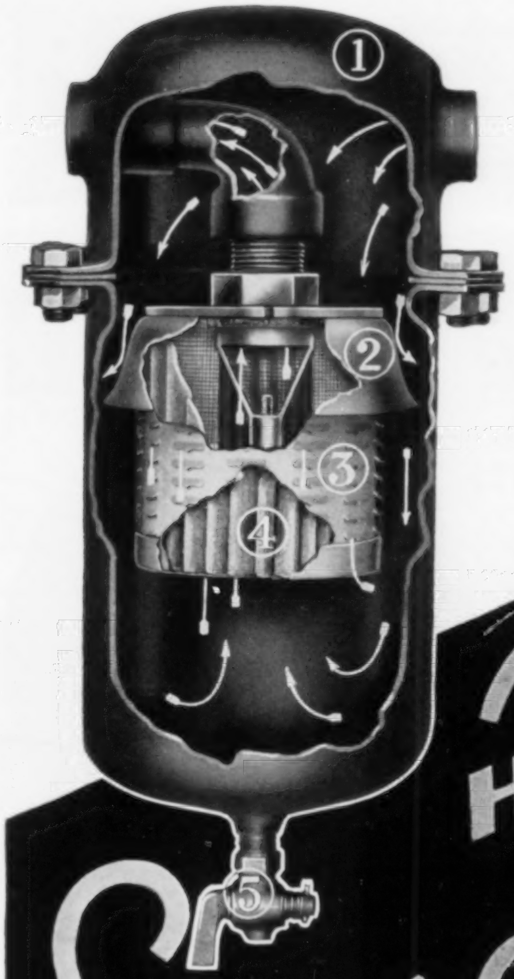
WRITE FOR A ROCKWOOD DRIVE RECOMMENDATION FOR YOUR COMPRESSORS. What is true of compressors is also true of other hard belt driven machines. EVERY ROCKWOOD DRIVE IS GUARANTEED—TO BE SATISFACTORY OR WE DO NOT WANT YOU TO KEEP IT.

Put Rockwood Drives on all your electric motor belt driven machines.

ROCKWOOD MANUFACTURING CO., INDIANAPOLIS, IND.

ROCKWOOD V-BELTS AND V-SHEAVES ROCKWOOD PIVOTED-MOTOR DRIVES

ROCKWOOD PAPER PULLEYS

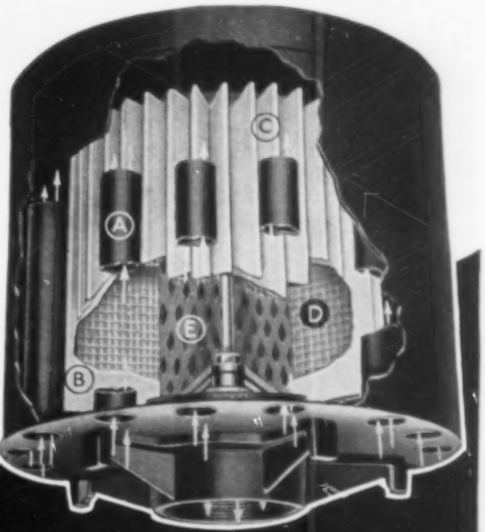


← MODEL CPH

for horizontal air transmission lines. Model CP for vertical lines. (1) container; (2) baffle; (3) housing; (4) insert; (5) drain cock.

MODEL DS →

Combination Silencer-filter for internal combustion engine and compressor intake. (A) Rectifying chamber (a series); (B) dry Feltex Filtering Medium; (C) Radial Fin Construction (D) rigid, galvanized mesh frame; (E) reinforcing tube.



HOW TO *Save Money*

WITH AIR FILTERS

» » » » Check over the machinery and processes under your supervision. Are gasoline, gas or Diesel engines, compressors, blowers or electric motors operating without efficient air filters? Do air-powered tools run on unfiltered air? Are air-using processes lacking clean, dry air? Is intricate, expensive machinery unprotected from dust?

AIR FILTERS ARE ECONOMIZERS

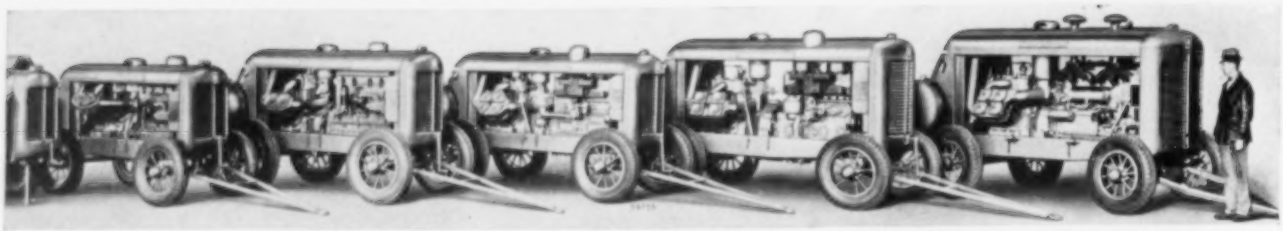
In every case, correct air filter installations will reduce operating expenses and maintenance costs. The reasons are simple. Abrasive dust is everywhere. Unless kept out by efficient filters, it scours away cylinder walls, wears out reciprocating parts, clogs delicate machinery. Foreign matter in air transmission lines (pipe scale, rust, dirt, oil and moisture) damages air-using tools; interferes with air-using processes. Facts and figures prove the savings made by high grade air filters. Use them everywhere and watch cost figures drop.

Air Filter PROTECTOMOTOR AIR FILTERS *Headquarters*

Protectomotor Air Filters 99.9% Efficient

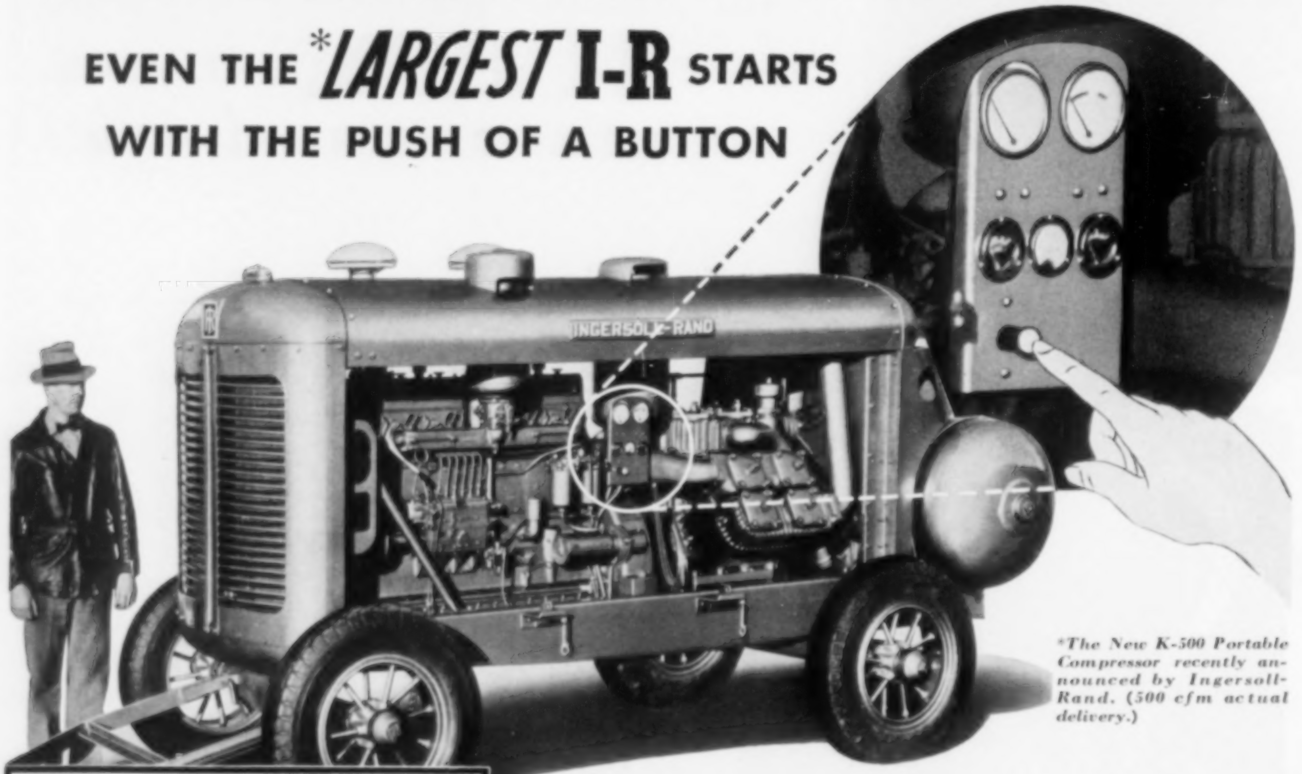
Tests made by the University of California prove that Protectomotors possess an efficiency only .1% less than absolute. This extraordinary performance is the result of several factors: (1) the patented Radial Fin Construction provides large filtering area in small space, minimum restriction of air flow, (2) the famous Feltex Filtering Medium is tough, long wearing, efficient in stopping the finest dust particles, (3) Protectomotors are built under the closest possible supervision from high quality, selected materials. You can SAVE MONEY using them—write for catalog and data.

STAYNEW FILTER CORP., 7 LEIGHTON AVE., ROCHESTER, N. Y.



WITH A
WAUKESHA *Oil* ENGINE

EVEN THE **LARGEST* I-R STARTS WITH THE PUSH OF A BUTTON



**The New K-500 Portable Compressor recently announced by Ingersoll-Rand. (500 cfm actual delivery.)*

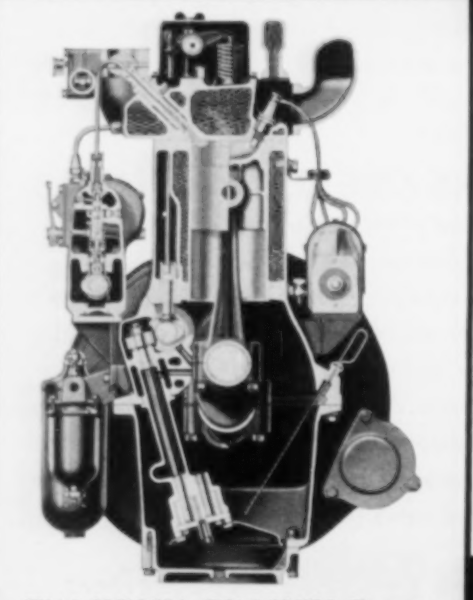
● The easiest, and quickest, starting oil engine in the world. That's what operators say about the Waukesha Oil Engine in the Ingersoll-Rand Compressor.

What's the secret of this quick, easy starting? *Low compression* and *spark ignition*. The engine requires only a standard battery electric starter. Smaller sizes are easily and often hand-cranked.

No auxiliary starting engine is needed with the Waukesha Spark Diesel Engine. It is *not* like the usual small-bore, compression ignition Diesel which requires a complete auxiliary gasoline starting engine with an extra clutch and transmission. With Waukesha there's only one engine to warm up.

A convenient primer atomizes and sprays a small charge of gasoline into the intake manifold. The fuel is quickly vaporized. The engine starts instantly. As soon as it fires it begins to function on fuel oil—without any auxiliary change-over mechanism whatever. Even in the coldest weather it needs no more priming than a gasoline engine. A Waukesha *warms up* on fuel oil.

All I-R Two-Stage Air Cooled Portable Compressors have *Waukesha Power Plants*—whether gasoline engine or oil engine powered. Write for Bulletins 1135 and 1138.

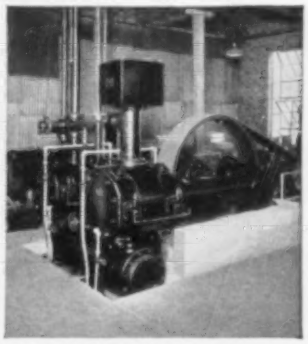


WAUKESHA ENGINES Power ALL I-R Portable Compressors

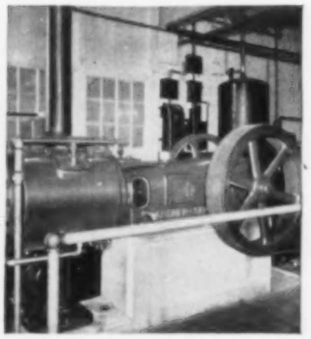
WAUKESHA MOTOR COMPANY · WAUKESHA, WIS.
NEW YORK TULSA LOS ANGELES

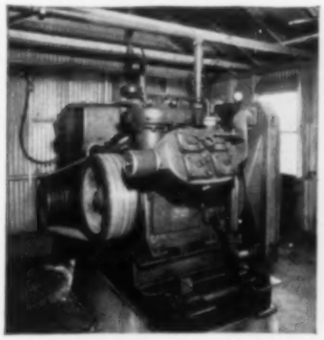
KEEPS VALVES WORKING

EXCAVATING


QUARRYING

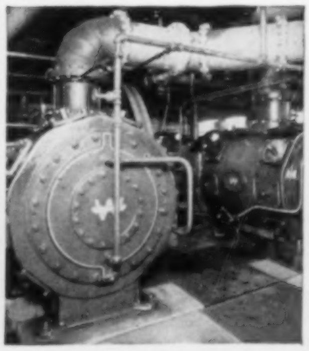
ROAD WORK


FACTORY


GOLD MINE

SEWER JOB

POWER HOUSE


GLASS WORKS

Regardless of...
MAKE,
SIZE,
SERVICE!

LET THESE PICTURES suggest that it might be profitable for you, also, to look to your air compressor lubrication.

Operators in all these fields are daily proving that they can keep their air compressors at top efficiency with less cost . . . by lubricating with *Texaco Alcaid, Algol or Ursa Oils.*

When you turn to Texaco, it is very possible that such benefits as: cleaner valves and ports, less maintenance, repairs, and replacements, more pressure with less power, will promptly result.

To help you gain these advantages, Texaco provides the practical services of a Lubrication Engineer. He will gladly help your men select and apply the lubricant best suited to your particular needs. Just phone the nearest of more than 2300 Texaco warehousing points, or write to:

The Texas Company, 135 E. 42nd St., N. Y., N. Y.

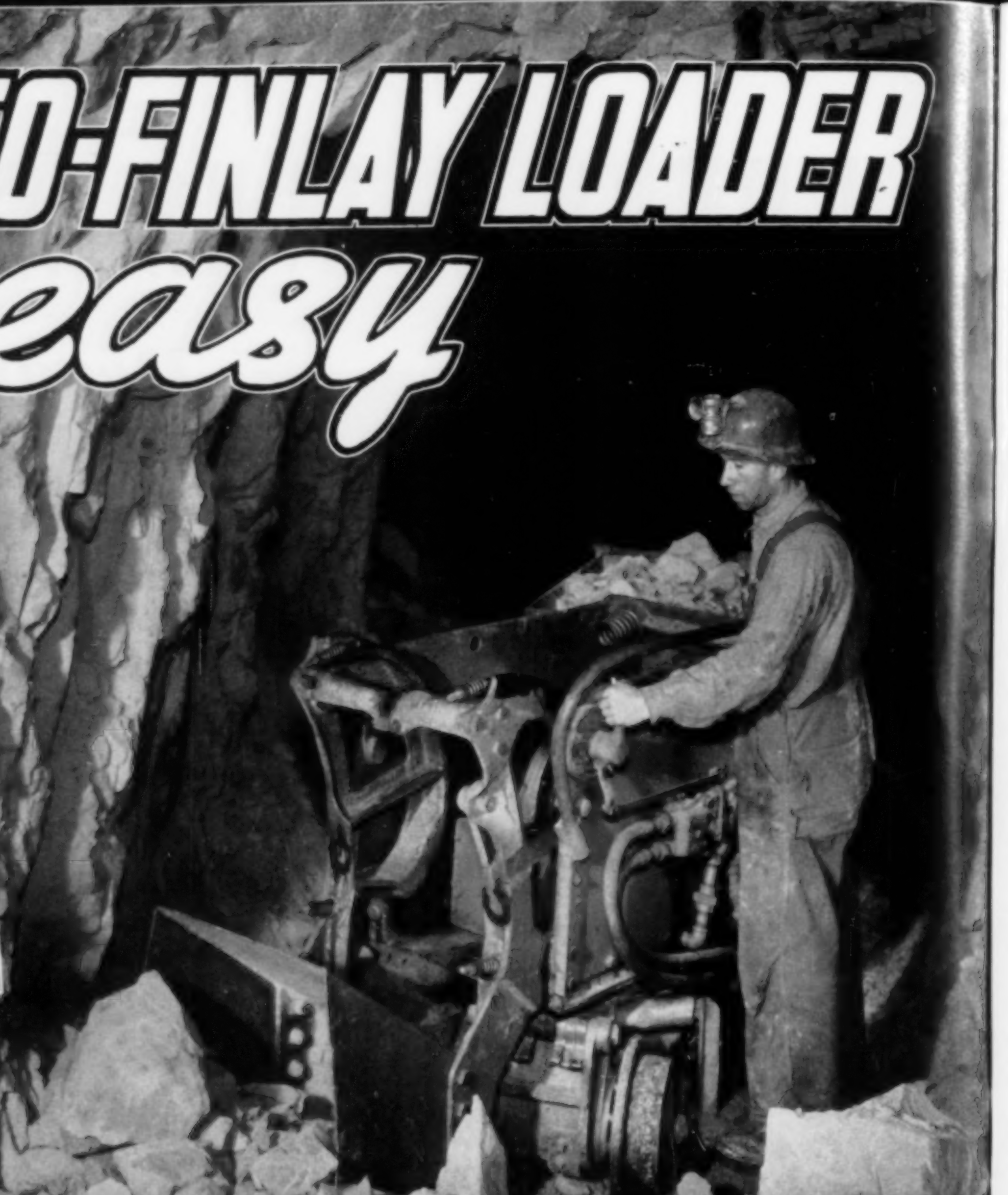
Texaco Dealers invite you to tune in The Texaco Star Theatre — a full hour of all-star entertainment — Every Wednesday Night — Columbia Network — 9:00 E.D.T., 8:00 E.S.T., 8:00 C.D.T., 7:00 C.S.T., 6:00 M.S.T., 5:00 P.S.T.

TEXACO

REG. T.M.

TEXACO
ALCAID, ALGOL AND URSA OILS

This EIMCO-FINLAY LOADER makes a hard job easy



Driving each way from a new shaft station at a famous Utah lead-zinc-silver mine, each of the two headings is being advanced seven feet a day with a total working force of only four men. Two men work on each shift—one drilling in one heading and the other mucking out in the other heading, as shown in the illustration above.

At the present time, with the headings in only about 100 ft. from the shaft, and with a good muck pile, the Eimco-Finlay operator can load the car, tram it to the skip-pocket, dump it, and return it to the loader in one minute. Usually he loads out the entire round (45 to 50 cars) in less than two working hours, leaving ample time for track and pipe work, and for such other odd jobs as may be required around the station.

Besides turning what would formerly have been the hardest kind of manual labor into an easy, interesting job, this Eimco-Finlay Loader is paying for itself very rapidly—not only through savings in direct mucking costs but also by speeding up important development work and reducing overhead expense. Two other Eimco-Finlays at this mine have already proved their money-saving value.

Throughout the entire mining world Eimco-Finlay Loaders have made hand loading as obsolete as hand drilling. Three standard models meet every underground requirement, from drifts as small as 5 ft. wide and 6 ft. high to the largest stopes and tunnels. Write for bulletins and tell us about your requirements.

THE EIMCO CORPORATION, Salt Lake City, Utah, U.S.A.

NEW YORK, 330 W. 42nd St.
CHICAGO, 333 No. Michigan Ave.
EL PASO, Mills Building
* SACRAMENTO, 1217 7th St

INGERSOLL-RAND, CO., LTD.
165 Queen Victoria St., London, Eng.
* **BRITISH MIN. SUP. CO. (PTY.), LTD.**
Troye House, Johannesburg, S. A.
* **HODGSON & CRANSTON**
Boulder Road, Kalgoorlie, Australia

* **CLYDE ENGINEERING, LTD.**
Wellington, New Zealand
* **COMPAGNIE INGERSOLL-RAND**
46 Rue de Courcelles, Paris, Fr.
* **MINE EQUIPMENT CO., LTD.**
Kirkland Lake, Ontario, Canada

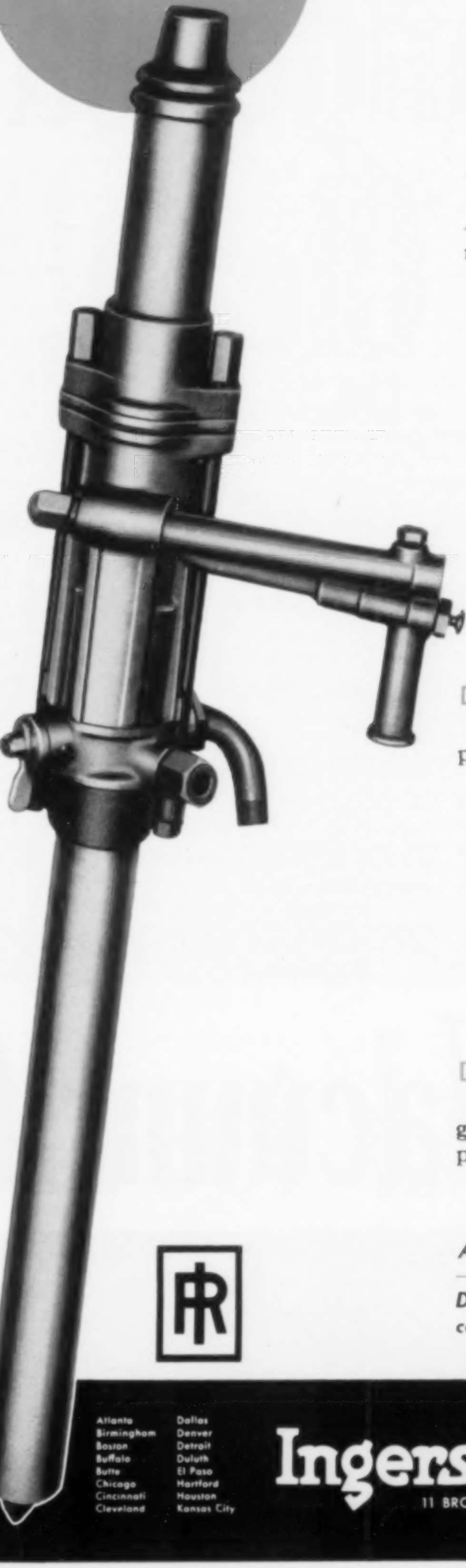
B. C. EQUIPMENT CO., LTD.
551 Howe St., Vancouver, B. C.
* **MARSMAN TRADING CORP.**
Manila and Baguio, P. I.
AMERICAN TRADING CO.
Tokyo, Japan

INTERNATIONAL MACH. CO.
Rio de Janeiro, Santiago and Antofagasta
DEMAS & NICOLAIDIS
Corai 4, Athens, Greece

J. E. TREACY COMPANY
Str. I. C. Bratianu No. 4
Ploesti, Roumania
HAEHRE & COMPANY
Slotsgt 7, Oslo, Norway

* *Replacement parts carried in stock by agents indicated by asterisks*

New The STOPEHAMER



It's the Balanced R-58

with Automatic Rotation

EASY HANDLING

The R-58 has fine balance—light weight—short overall length—flexible feed control—ideally located air and water hose connections and throttle control.

Balance—The center of gravity of this Stopehamer is such that it assumes a natural drilling position when it is picked up. This makes it easy to set the drill in any operating position.

Light Weight—Only 116 pounds—yet the fastest Stopehamer Ingersoll-Rand has ever built.

Short Overall Length—Only 59 inches. Short length prevents the drill from being top heavy—means greater safety for the operator and easier handling. Ideal for use in narrow, restricted stopes, as well as in large stopes.

DURABILITY

The R-58 stays underground—this has been convincingly proved in a number of mining districts.

The R-58 piston has greater metal sections than any other I-R stoper piston.

The valve is simple and sturdy.

The chuck cleaning system keeps cuttings and water out of the machine better than any other method we have yet devised. Bearing areas are larger and lubrication is positive.

DRILLING SPEED

The speed and easy handling qualities of the R-58 insure greater footage per shift. This makes skilled miners even more productive.

Ask for detailed information about the cost-cutting R-58—Form 2647. Contact the nearest Ingersoll-Rand Branch. Don't overlook this opportunity to reduce your drilling costs. Get an R-58 to-day.

915-5

Atlanta
Birmingham
Boston
Buffalo
Butte
Chicago
Cincinnati
Cleveland
Dallas
Denver
Detroit
Duluth
El Paso
Hartford
Houston
Kansas City

Ingersoll-Rand

11 BROADWAY, NEW YORK CITY

Knoxville
Los Angeles
Newark
New Orleans
New York
Philadelphia
Picher
Pittsburgh
Pottsville
Salt Lake City
San Francisco
Scranton
Seattle
St. Louis
St. Paul
Tulsa
Washington

WITH GARGOYLE SUPER CYLINDER OIL 600W—

Steam Condensate Comes Clean!

Gargoyle Super Cylinder Oil 600W separates quickly from steam condensate. This means:

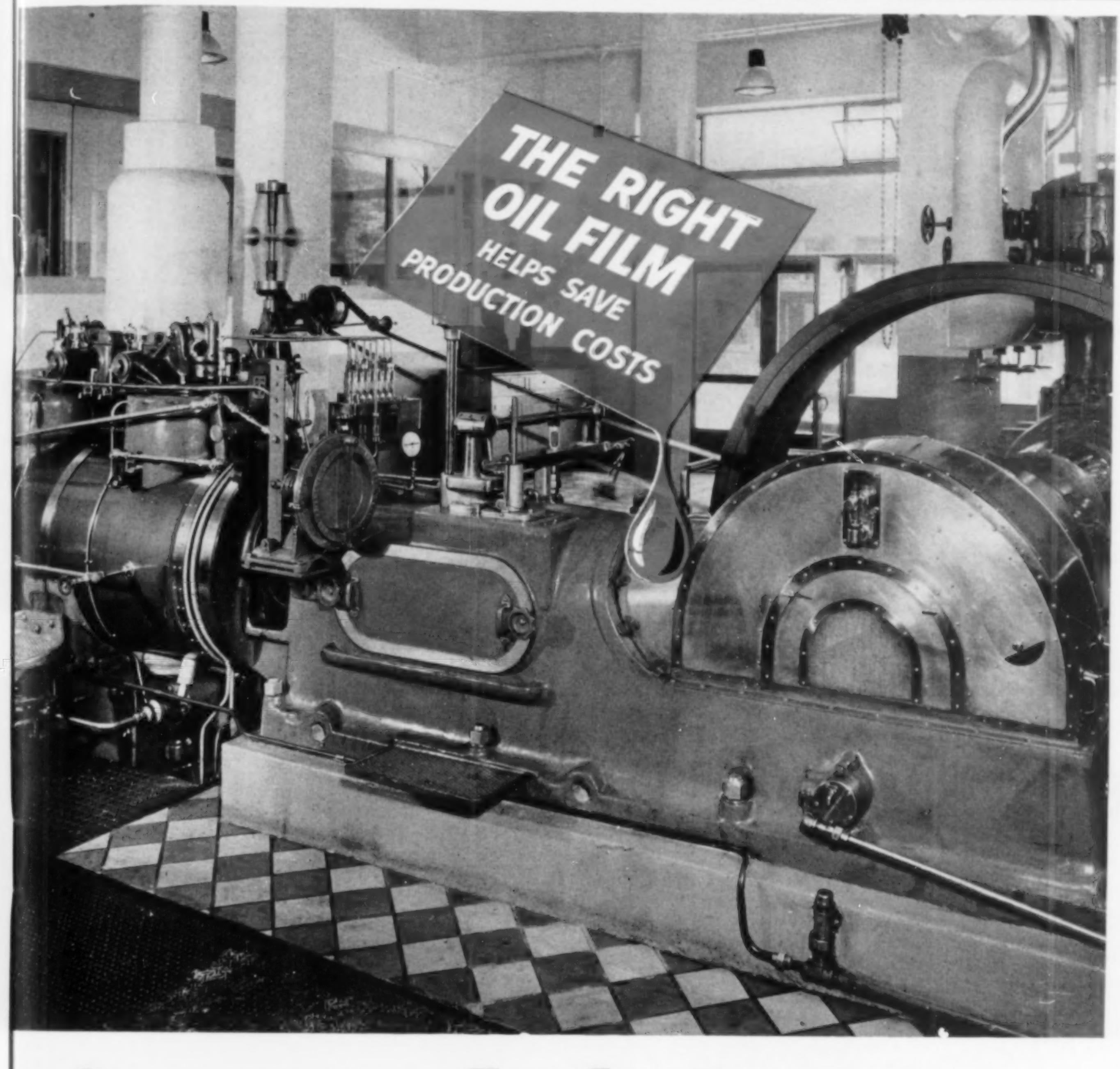
- ☛ Maximum boiler efficiency—rapid heat transfer; no overheated tubes; minimum boiler priming.
- ☛ Maximum processing efficiency—when steam condensate is used in processing equipment.

CALL IN Socony-Vacuum for

You'll Profit from these "Exclusives"

☛ **SKILLED LUBRICATION COUNSEL** of a Socony-Vacuum man backed by 74 years' experience . . . the greatest in the Petroleum Industry.

☛ **A COMPLETE LINE** of Lubricants . . . the scientifically correct lubricant for every type of machine you now own . . . or will buy.



Correct Lubrication

NEW LUBRICANTS ahead of new needs . . . developed in close cooperation with machine builders by famous Socony-Vacuum laboratories.

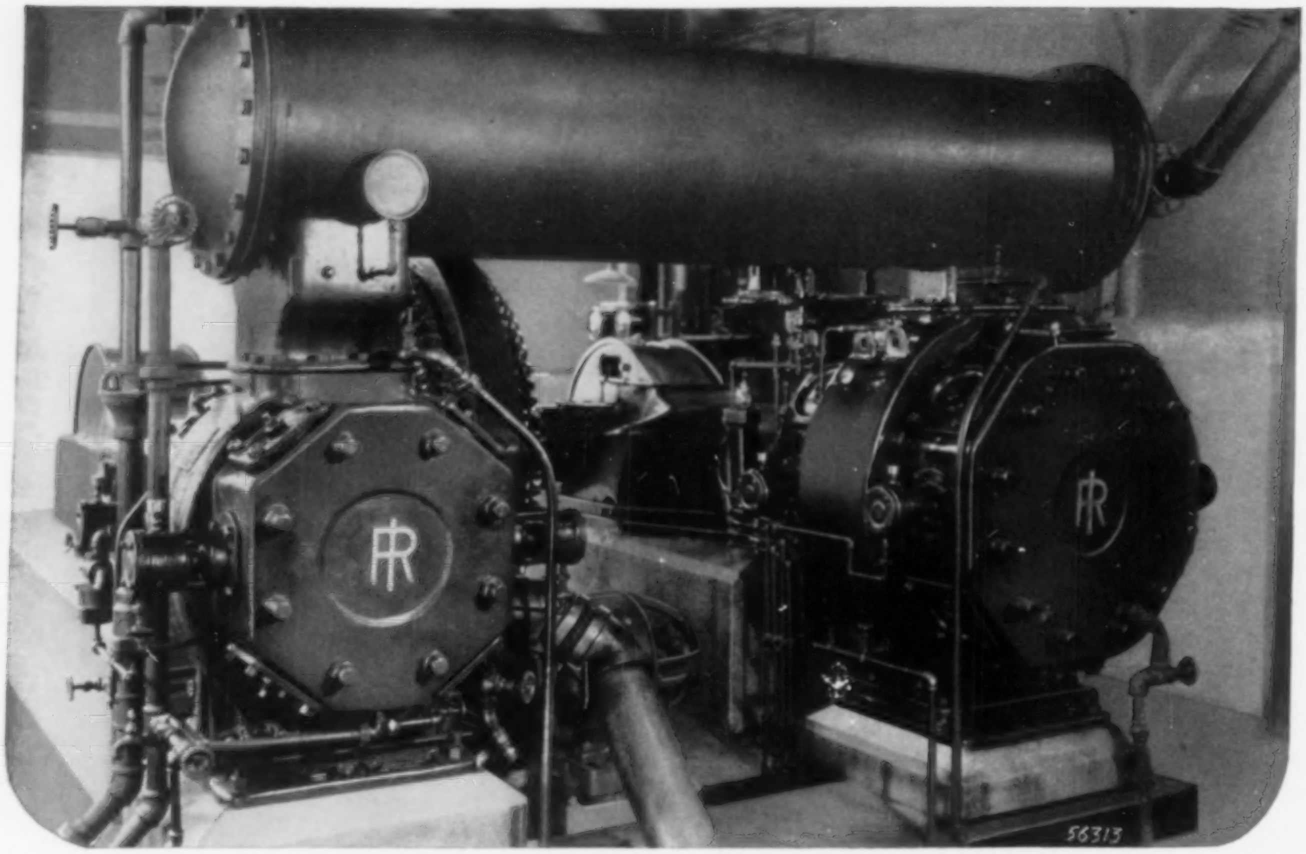
HALF A MILLION CASE HISTORIES to guide our engineers in recommending the right use of these lubricants to earn Lubrication Profits for you.

DISTRIBUTION throughout the world. The same high-quality lubricants available everywhere.

• • •

SOCONY-VACUUM OIL CO., INC.
Standard Oil of New York Division • White Star Division • Lubrite Division • Chicago Division • White Eagle Division • Wadhams Division • Magnolia Petroleum Company • General Petroleum Corporation of California

GARGOYLE
Lubricants



OVER 90,000 HOURS IN 11 YEARS

THE KIND OF COMPRESSOR PERFORMANCE ANY MINE NEEDS

Since 1929 this Ingersoll-Rand 14"-stroke Class PRE-2 has been furnishing the air required at the Crescent Mine of the Bunker-Hill & Sullivan Mining Company. For 10 years it ran almost continuously 24 hours a day, every day in the year.

During all these years there have been no delays due to failure of the compressor. In fact, spare valves remained in the storeroom for 11 years. One valve plate was replaced recently—the only repair part which has been used.

Ingersoll-Rand synchronous-motor-driven compressors are the recognized standard in the mining industry. These machines are designed and built for heavy-duty continuous service—the only type of service which "fills the bill" at the mine. Sizes range from 75 to 3000 hp.

When you are considering a compressor for your mine, think first of Ingersoll-Rand. A representative who knows the problems is located near you and will be pleased to consult with you concerning your needs.

Other I-R Products: Compressors, Pumps, Condensers, Blowers, Vacuum Pumps, Diesels, Refrigerating Units, Rock Drills and Pneumatic Tools.

Atlanta
Birmingham
Boston
Buffalo
Butte
Chicago
Cincinnati
Cleveland

Dallas
Denver
Detroit
Duluth
El Paso
Hartford
Houston
Kansas City

Ingersoll-Rand
11 BROADWAY, NEW YORK CITY

906-1

Knoxville
Los Angeles
Newark
New Orleans
New York
Philadelphia
Picher
Pittsburgh

Pottsville
Salt Lake City
San Francisco
Scranton
Seattle
St. Louis
St. Paul
Tulsa
Washington

Experienced drillers say:

"BETHLEHEM SUPERIOR'S THE STANDBY"

IN MINES . . .

IN TUNNELS . . .

IN HIGHWAYS . . .

IN QUARRIES . . .

IN DAMS . . .

IN FOUNDATIONS

Bethlehem Superior Hollow Drill Steel is a favorite among experienced drillers everywhere. The hole in Superior is well-centered, free from pits or blemishes which might concentrate stresses causing fatigue failures. The steel itself is clean, tough, pre-tested to insure uniform response to handling.

Use Bethlehem Superior Hollow Drill Steel in your own drilling operations. You'll see why experienced drillers on all types of drilling jobs agree that "Superior's the standby."

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

RESEARCH . . . Another Phase of NORTON SERVICE

HELPS YOU IN TWO IMPORTANT WAYS . .

Through Grinding Wheel Improvement

MANY of the fifty trained scientists and technicians in the Norton Laboratories are thinking chiefly of the future—are busy developing new abrasives, new bonds and improved manufacturing processes that you may have better grinding wheels tomorrow. It is their vision and skill that gave the grinding industry B-E bond, controlled structure, diamond wheels, I-R Crystolon abrasive, Norbide (Norton Boron Carbide) and many other outstanding Norton developments.

Through Grinding Wheel Application

ANOTHER part of the laboratory staff specializes on the immediate present—on solving customers' current grinding problems. Practical laboratory engineers cooperate with Norton distributors, representatives and field engineers to determine by actual tests, both in the laboratories and in the customer's plant, the correct wheels and grinding procedure.

You can depend on Norton Service to solve your grinding problems.

W-757

NORTON COMPANY
WORCESTER, MASS.
New York Chicago Detroit
Philadelphia Pittsburgh Hartford
Cleveland Hamilton, Ont.
BEHR-MANNING DIVISION, TROY, N. Y.

NORTON ABRASIVES

ON THE COVER

OUR cover picture shows the initial installation of two 36,000-kw. generating units in the power house of Pickwick Landing Dam, a TVA creation. These generators went into service in 1938. The plant runs at peak load whenever sufficient water is available. The water requirement for full-capacity operation is about 19,000 second-feet. When all the TVA dams on the Tennessee River and its tributaries are in place, it is expected that the flow will never drop below 24,000 second-feet.

●

IN THIS ISSUE

THERE are pieces of furniture in some of the old homes in the Tennessee Valley that were shipped from New York or Philadelphia entirely by water. They made the trip via New Orleans, being transported from that city up the Mississippi, Ohio, and Tennessee rivers in packet boats. When the improvements now underway in the Tennessee River are completed, water haulage will again become an important factor. At the same time, it is expected that the industrial and agricultural products of the area will provide increasing traffic for the railroads. Our leading article describes how the Tennessee River is being converted into one of the world's finest inland waterway transportation arteries.

●

OUR second article deals with R. Steel & Sons, Inc., a firm that is typical of the better-grade shops which minister to the needs of the mechanical world. Everyone knows that replacement parts for most machines are made better and cheaper by the original manufacturer, but there are cases where something is wanted in a big hurry and the factory is too far away, or when a job calls for equipment that has to be made for it. Then a machine shop of the type described is a friend indeed.

●

THE magic touch of Walt Disney has delighted millions of motion-picture fans the world over. It is pleasant news that his new studio will enable him to turn out his colorful and appealing animated cartoons in greater numbers.

●

AN UNUSUAL type of mining is described in *Whit Kuntz Stays Off Relief*. In a region that is seldom visited by rainfall, ordinary placer methods are of no avail. But men will have their gold regardless of the elements, so in this case they use air to winnow the worthless dirt from the precious flakes of metal.

●

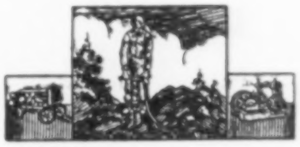
IN THIS issue is A. D. Karr's final article in his series on *Steam Condensers*, which has given many persons a better understanding of the apparatus that is indispensable to modern steam power plants.

Compressed Air Magazine

Copyright 1940 by Compressed Air Magazine Company

Volume 45 **MAY, 1940** **Number 5**

C. H. Vivian, *Editor*
A. M. Hoffmann, *Assistant Editor*
J. W. Young, *Advertising Manager*
J. F. Kenney, *Business Manager*
D. Y. Marshall, *European Correspondent*, 243 Upper Thames St., London, E.C.4.
F. A. McLean, *Canadian Correspondent*, New Birks Bldg., Montreal, Quebec.



EDITORIAL CONTENTS

Dredging the Tennessee River—*C. H Vivian* 6138
Handy Men to Many Industries—*R. G. Skerrett* 6143
Walt Disney's Gang in New Home 6147
Steam Condensers, Part III—*A. D. Karr* 6149
Whit Kuntz Gets His Beans—*Carey Holbrook* 6155
No Air in Coal Pile—No Fire 6157
Painting Pictures with an Air Brush 6158
Editorials—Tennessee River Navigation—Nation's "Oldest" Concern . 6159
Air-Operated Warning Signal 6160
Hoist Gets Radio Orders 6160
Ladle with Self-Locking Tilting Device 6160
Pneumatic Rams Empty Clothes Washer 6160
Industrial Notes 6161

ADVERTISING INDEX

American Steel & Wire Co.	16
Atlas Drop Forge Co.	17
Bethlehem Steel Company	11
Bucyrus-Erie Company	4th Cover
Burgess Battery Company	21
Columbia Steel Co.	16
Compressed Air Magazine Co.	24
Conrader Co., R.	15
Eimco Corporation, The	6
Goodrich Company, The B. F.	14
Hercules Powder Co., Inc.	18
Ingersoll-Rand Co.	7, 10, 13, 22, 26
Jarecki Manufacturing Co.	23
Logan Engineering Company	21
Maxim Silencer Co., The	19
National Forge & Ordnance Co.	17
Naylor Pipe Company	23
New Jersey Meter Co.	19
Norton Company	12
Raybestos-Manhattan, Inc.	15
Rockwood Manufacturing Co.	Second Cover
Socony-Vacuum Oil Co., Inc.	8-9
Square D Company	17
Straight Line Foundry & Machine Corporation	17
Staynew Filter Corp.	3
Texas Company, The	5
Timken Roller Bearing Co., The	25
Toledo Pipe Threading Machine Company, The	21
United States Steel	16
Vogt Machine Co., Inc., Henry	20
Wagner Electric Corp.	15
Waukesha Motor Company	4
Willson Products Incorporated	23

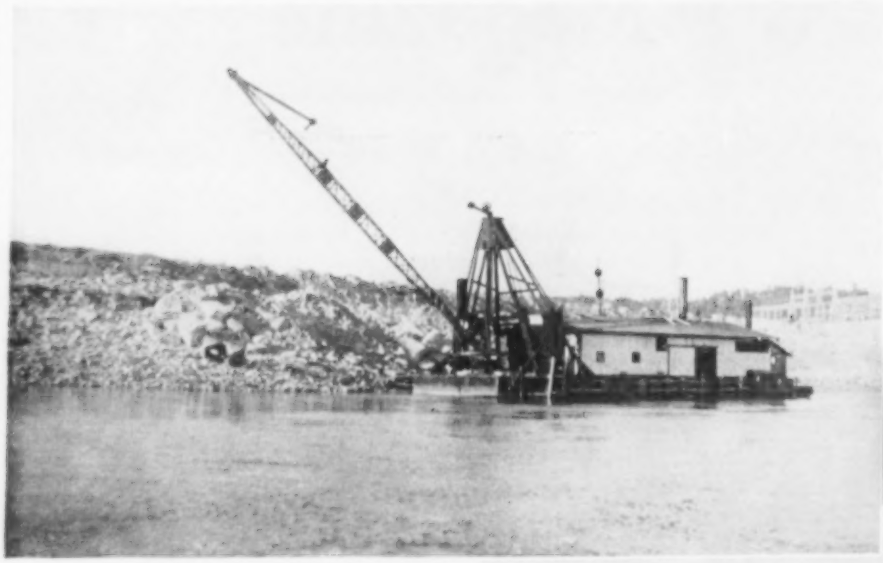
A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

CCA Member Controlled Circulation Audit.

Published by Compressed Air Magazine Company. G. W. Morrison, president; J. F. Kenney, vice-president; F. E. Kutz, secretary-treasurer.
Business, editorial, and publication offices, Phillipsburg, N. J.
Advertising Office, 11 Broadway, New York, N. Y.
Annual subscription price: domestic, $3.00; foreign, $3.50. Single copies, 35 cents.
Compressed Air Magazine is on file in many libraries and is indexed in Industrial Arts Index.

Dredging the Tennessee River

C. H. Vivian



DREDGE, DERRICK, AND BARGE

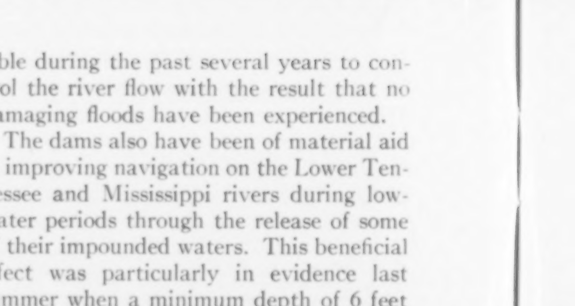
At the right is the dipper dredge "LaSalle" loading rock on to a barge. The material in the foreground is part of the result of a blast of several hundred holes. The derrick boat "Minneapolis" is shown at the left standing alongside a barge unloading point on one bank of the river just below Pickwick Landing Dam. In the picture below is seen a loaded barge being pushed by the diesel towboat "Atlas."

THE system of dams being erected on the Tennessee River and its tributaries by the Tennessee Valley Authority is designed to control the river flow so as to prevent floods and to improve navigation. Although the dam-building program will not be completed for several years, these intended benefits have already begun to manifest themselves, and as the program progresses they will become more and more evident. Meanwhile, the most striking and most publicized aspect of the TVA movement—the generation of power—is making low-cost electricity available to a continually increasing number of consumers in the 40,000-square-mile area that constitutes the Tennessee River drainage basin. Including the facilities it has purchased from former operators, the TVA now has an installed, rated generating capacity in excess of 906,000 kw., of which some 761,000 kw. is in hydraulic plants and the remainder in steam plants.

An accompanying illustration shows how the 650-mile stretch of the Tennessee River between its confluence with the Ohio at Paducah, Ky., and Knoxville, Tenn., will be converted into a series of pools created by a chain of nine dams. Six of these structures are already in place, and the three others are underway. It is contemplated that all nine will be in service by 1945. In addition, Ohio River Dam No. 52, a low-navigation structure, has improved navigating conditions immediately below Kentucky Dam, and Lock and Dam No. 1, a low-lift structure 2.5 miles below Wilson Dam, connects the Pickwick Landing and Wilson reservoirs. Besides the dams on the main river, the TVA program includes the rearing of dams on some of the principal tributaries. Of these, Norris Dam on the Clinch River has been completed for several years, and Hiwassee Dam, on the same river, is in course of construction.

The primary purpose of the latter structures is to impound water during periods of high flow both to aid in averting floods downstream and to have water available for release later at times of low flow. The water will pass through turbines at the points of release and, accordingly, contribute to the supply of electrical energy. This production of power will, of course be intermittent. On the other hand, the release of the stored water during the dry season will make it possible to maintain the river flow at a rate considerably above its normal minimum and will, therefore, enable the hydro-electric plants located on the main stream to operate continuously.

The main-river reservoirs will be drawn down to certain prescribed levels during the dry season, but never so far as to reduce seriously the generating capacity of their power plants. In their partially empty states they will provide room for impounding surplus water during the rainy season, and thus eliminate the flood menace that was formerly almost an annual occurrence. As a matter of fact, even though the system of dams is incomplete, it has made it possible during the past several years to control the river flow with the result that no damaging floods have been experienced.



The dams also have been of material aid in improving navigation on the Lower Tennessee and Mississippi rivers during low-water periods through the release of some of their impounded waters. This beneficial effect was particularly in evidence last summer when a minimum depth of 6 feet was maintained chiefly because water was released from Norris Reservoir. It was not originally intended that this reservoir

PICKWICK LANDING DAM

An aerial view of the structure in western Tennessee, and a section of the 46,800-acre lake impounded by it. The dam has a maximum height of 113 feet, is 7,715 feet long, and backs water 50 miles to Lock and Dam No. 1 at the lower end of Florence Canal 2.5 miles below Wilson Dam. The Pickwick Landing Dam lock, seen at the far side of the river channel, is 110 feet wide, 600 feet long, and capable of raising vessels 67 feet in one lift.

DRILL BOAT "HORNET II"

The twenty drills mounted in a line along one side of the boat made it possible to drill a 100-foot row of holes on 5-foot centers with the craft remaining in one position. The "Hornet II" is the original boat of this type that was designed by one of the contractors on the present job in 1933 and subsequently rebuilt by him as shown.

should be drawn down below Elevation 960; but to meet the needs of the navigation interests, as well as to add to the generating capacity of the main-river plants, it was lowered to Elevation 935. It was estimated one time last summer that one-tenth of all the water in the Mississippi at Memphis, Tenn., was coming from Norris Reservoir located on a comparatively small stream and more than 700 miles away.

When all the main-river dams are in service, each one will back up the water to the base of the one immediately upstream from it. This will provide still-water navigation throughout the 650-mile stretch to Knoxville, and will, it is claimed, afford the most economical operation of barge lines of the rivers in the country. The transfer of boats from one level to another will be made by means of locks. By erecting a comparatively few high dams, instead of numerous low ones, the number of lockages and, incidentally, the locking time will be reduced.

The construction of high dams will have another beneficial effect upon navigation, and that is the creation of wide and deep channels. This is of importance, inasmuch as the towboat horsepower required to pull a given number of barges rises considerably with the restriction of the width and depth of a channel. Ample depth is particularly desirable, because the effect of a towboat operating in still water is felt in a measurable degree to a depth three times its draft.

It will be apparent that the pools behind the dams will gradually become shallower toward their upstream ends. Consequently, the depth in some areas will be less at low-water stage than is required for the 9-foot navigation prescribed in the TVA Act. To correct this condition, channels will be dredged at those points in nearly all the pools. By specifying higher dams, it would have been possible, of course, to obtain the desired depth in the upstream ends; but this would have entailed greater cost both for the dams themselves and for the purchase of additional lands for the enlarged reservoir sites. Furthermore, higher dams would have resulted in deeper water not only in the reservoirs but also in the tailraces of the power houses located at the upstream sides of the dams, and for this reason would not have increased operating heads nor generating capacities. All these factors were considered in the economic studies that were conducted prior to planning the system of dams. It was finally determined that it would be less expensive and more desirable to do a certain amount of dredging for navigation channels at the upstream ends of the pools.

This dredging program has already been started, operations now being underway just downstream from Pickwick Landing and Guntersville dams. It is expected that bids will be asked this spring for work below Hales Bar and Wheeler dams, and in the spring of 1941 for that below Chickamauga Dam. The schedule further requires that the dredging of the channels below Watts Bar Dam and the proposed Coulter Shoals Dam be started in 1942. All these projects will be completed by 1945; and, as the main-river dam system is to be finished by that time, there will then be available as far upstream as Knoxville a channel of adequate depth for 9-foot navigation.

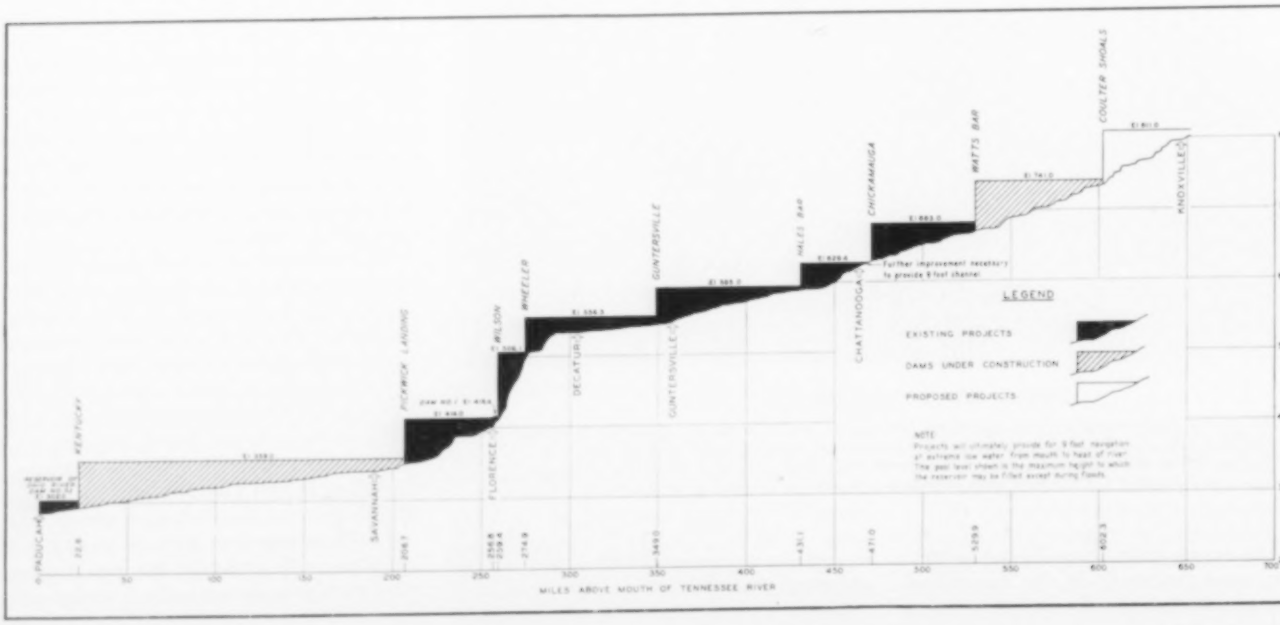
Of the two dredging operations now in progress, the one below Guntersville Dam is being conducted by the McWilliams Dredging Corporation of Chicago under a contract amounting to approximately $199,000. The second and larger one, below Pickwick Landing Dam, will be described in some detail. The work there is being done under a contract held jointly by the Al Johnson Construction Company and the LaCrosse Dredging Corporation, both of Minneapolis, Minn. The contract price is $958,000.

Pickwick Landing Dam is at present the farthest downstream of the TVA dams. It is situated about 207 miles above the mouth of the Tennessee River and a few miles upstream from Savannah, Tenn. The structure itself is in southwestern Tennessee, but its pool, which reaches 50 miles upstream, extends from Tennessee through the northeastern corner of Mississippi into Alabama. Kentucky Dam, formerly designated as Gilbertsville Dam, is now being constructed at a point 184 miles downstream from Pickwick Landing Dam, to which it will back up water. However, the depth in certain parts of the upstream end of the pool will not be sufficient to provide a channel for 9-foot navigation, and so the current dredging work is being done. Kentucky Dam will not be completed until 1944 or 1945; but as considerable traffic will move up and down the river in the meantime, the channel-improvement program is being inaugurated now to widen as well as to deepen the present tortuous channel so that larger tows of deeper draft can be accommodated even before that stretch of the stream becomes a placid pool.

A total of 12 miles of river bottom immediately downstream from Pickwick Landing Dam is to be dredged, but not in a continuous section. Approximately 85 per cent of the work will be done in Big Bend Shoals, which extend for 3 miles below the dam and have long presented a hazard to navigators. The remainder of the contract is about 8 miles downstream, at Wolf Island Shoals, where the operations will cover a stretch of waterway three-fourths of a mile long.

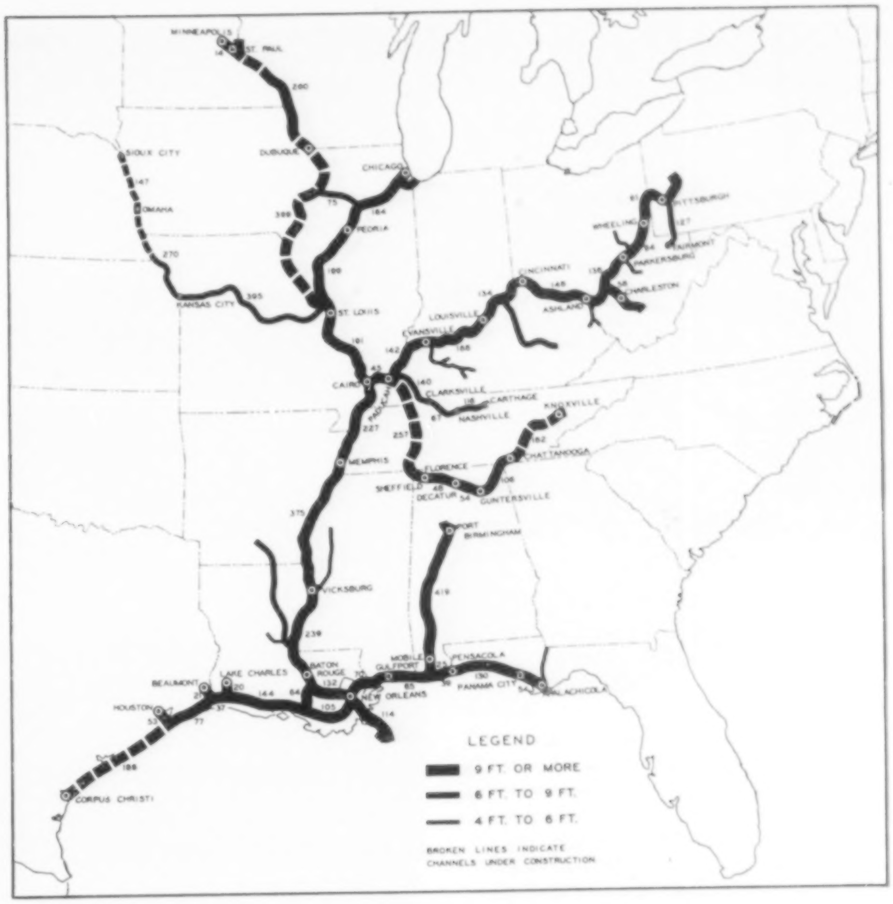
The work involves the dredging of a channel 300 feet wide at the bottom and deep enough for boats of 9-foot draft at low-water level. To assure sufficient draft, excavating is being carried to a point 11 feet below the expected low-water level. This will necessitate the removal of 375,500 cubic yards of material, of which 358,100 cubic yards will come from the Big Bend Shoals area and 17,400 cubic yards from the Wolf Island Shoals area. It is estimated that 330,000 cubic yards is ledge rock and the remainder loose material. Approximately 100,000 cubic yards of the rock will be deposited along the banks of the river to prevent their erosion when Pickwick Landing Dam is discharging its maximum volume of water. These riprap protection blankets will enlarge and extend those that were placed during the construction of the dam. Some marker mounds also will be built up to serve as navigation aids. The spoil not so used will be disposed of in areas designated by the TVA.

Work was started on October 19, 1939, and is to be completed in 520 calendar days. The contractors are not required, however, to carry on during the period from January 1 to May 1, as this is normally a rainy season during which the discharge from Pickwick Landing Dam may be so heavy as to result in a depth and velocity of water too great to permit working effectively. This condition prevails when the discharge reaches 60,000 second-feet. Operations were halted this year on



PROFILE OF TENNESSEE RIVER POOLS

This shows how, by 1945, barges will be free to move on still water from the mouth of the Tennessee to Knoxville. In that stretch they will be elevated approximately 500 feet by means of locks. Note that the lowermost dam is on the Ohio River, into which the Tennessee flows. With the exception of the latter, and low-lift Dam No. 1 at the Florence Canal, the other structures will be on the Tennessee River proper. They are nine in number, and all but three have been completed.


MINNEAPOLIS
ST. PAUL
14
200
SIOUX CITY
147
OMAHA
270
KANSAS CITY
395
DUBUQUE
CHICAGO
75
164
309
PEORIA
190
ST. LOUIS
181
CAIRO
45
PADUCAH
142
EVANSVILLE
188
LOUISVILLE
134
CINCINNATI
148
ASHLAND
136
58
CHARLESTON
PARKERSBURG
94
FAIRMONT
WHEELING
127
PITTSBURGH
140
CLARKSVILLE
118
CARTHAGE
67
NASHVILLE
KNOXVILLE
182
CHATTANOOGA
257
227
MEMPHIS
FLORENCE
SHEFFIELD
48
DECATUR
54
GUNTERSVILLE
106
375
PORT BIRMINGHAM
419
VICKSBURG
239
BATON ROUGE
70
132
MOBILE
GULFPORT
25
PENSACOLA
65
130
30
PANAMA CITY
54
APALACHICOLA
NEW ORLEANS
105
114
64
144
LAKE CHARLES
20
BEAUMONT
21
37
77
HOUSTON
53
188
CORPUS CHRISTI
LEGEND
9 FT. OR MORE
6 FT. TO 9 FT.
4 FT. TO 6 FT.
BROKEN LINES INDICATE CHANNELS UNDER CONSTRUCTION

MISSISSIPPI RIVER NAVIGATION SYSTEM

The Tennessee River will be a link in the vast network of inland and coastal waterways shown here. When completed, it will extend for a distance of 5,700 miles through the interior of the country and along the Gulf Coast.

February 16, at which time all floating equipment was moved through the lock and moored in the still water above Pickwick Landing Dam to await the return of suitable working conditions. Within the period of approximately four months during which they were active, the contractors covered an area roughly 180 feet wide and 3,500 feet long.

The river bed ordinarily consists of a shallow surficial deposit of sand and gravel underlain by rock. The rock is of sedimentary origin and lies in horizontal beds. The normal sequence of formations from the surface downward is Chattanooga shale, Ross limestone, and Laurel limestone, with the last-mentioned one extending into the excavation zone in only one short stretch of the river. In the Wolf Island Shoals area, the bedrock is generally of cemented gravel and sandstone and is relatively soft.

During the operations thus far completed, most of the material encountered was a dense, hard limestone of the Ross formation. It contains a large amount of silica and includes lumps of chert and fossilized material. For a short distance the bottom was of Chattanooga shale, which is dense and hard in its natural position but susceptible to rapid weathering and softening upon exposure to the air. This shale proved much easier to drill than the limestone. All the rock breaks readily along the bedding planes; and at times this produces considerable quantities of large slabs in the shot rock so that secondary blasting is often required to reduce them to handling size. The occasional existence of clay and mud seams between layers of hard rock increases the tendency to break out large slabs; and in some instances the explosive heaves up pieces of rock in which three or four drill holes appear. The manner in which the rock breaks has shown great change within a short distance, however, and in some cases a transition from large pieces to finely broken material has taken place within 100 feet.

The contractors' plant is well adapted to underwater rock excavation of this kind. A specially designed and constructed drill boat, the *Hornet II*, a 3½-cubic-yard dipper dredge, the *LaSalle*, and a derrick boat with an 80-foot boom, the *Minneapolis*, constitute the principal excavating equipment. Two diesel-engined, pusher-type river towboats, the *Vance* and the *Atlas*, handle the flat-deck steel barges used for transporting spoil. Two draglines, a Bucyrus-Erie 43-B diesel-driven unit with a 60-foot boom and a 2-cubic-yard bucket, and a Northwest gasoline-driven machine with a 45-foot boom and a 1¼-cubic-yard bucket unload the barges and place the rock fill and riprap. They are mounted on crawlers and travel along the bank, first dragging the material off the barges into shallow water at the river's edge and then retrieving it and placing it where desired. Six 3-cubic-yard dump trucks were utilized for hauling spoil for deposition in a dike extending along one river-bank slope downstream from the dam for a distance of 2,200 feet, a location which the draglines could not reach.

The drill boat differs from conventional craft of its kind. Instead of carrying a few drills that are moved to different positions to complete a line of holes, the *Hornet II* has twenty drills mounted along one side and spaced 5 feet apart. This makes it possible to drill a row of twenty holes from one positioning of the boat and without shifting the drills. The craft has a wood hull 100 feet long, 25 feet wide, and 5½ feet deep. It has a deckhouse of 80x19 feet that contains machinery for operating it and repairing its equipment. It is the original boat of the type just described and was designed by the Al Johnson Construction Company in 1933 and later rebuilt as it exists today. In its earlier form it was successfully employed in dredging operations conducted by the company at Davenport, Iowa, and Utica, Ill.

The drills that are now being used are: sixteen Ingersoll-Rand DA-35 drifters, two Ingersoll-Rand N-75 drifters, and four older machines that were included in the craft's original equipment. Each drill is mounted on a 170-pound slab-back. A catwalk extends along the side of the boat in front of the drills for the convenience of the workmen. Compressed air is supplied by two compressors, each driven by V-belts from an 8-cylinder diesel engine. Each unit delivers 623 cfm. of air at 100 pounds pressure. The air-operated shop machinery consists of an I-R No. 50 drill-steel sharpener, an oil furnace, and a 4K shank grinder. This is supplemented by the accessories required for making up and reconditioning drill steel. Steels are made up in various lengths from 14 to 22 feet, the latter being the longest that the drill towers will accommodate.

To prevent rocks and sediment from falling into the holes, drilling is done through 2½-inch sand pipes, which are put in position by pounding them down to rock through the overburden of the river bed. These pipes may be raised or lowered by the drill-tower mechanism. Hollow, round steel of 1¼-inch section with 2¼-inch bits is used. The same gauge of bit is retained throughout the depth of a hole; and ordinarily a hole is completed with the original steel, although a second steel may be required when excessively hard or abrasive rock is encountered. The depth ranges from 4 to 10 feet, with the average hole between 7 and 8 feet deep.

The drill boat works across the stream—that is, it is stationed with its sides parallel

DIKE AND DRAGLINE

At the left is a view of the end of a completed section of the dike that was built on top of the slope along one bank of the Tennessee for a distance of 2,200 feet downstream from the dam. The picture also is evidence of the unusually severe weather that was experienced in the South this winter. Below is a Bucyrus-Erie dragline placing material that it had previously dragged off a barge into the water in rearing the protective wall along the bank.

to the river banks. Six drills are usually operated at one time, the drillers starting with the first six drills at either end of the row. As soon as a driller completes his hole, he moves on down the line to the first drill that is not in use. Each man, in turn, repeats this procedure until all twenty holes have been drilled. The anchoring spuds at one end of the *Hornet II*, either upstream or downstream, are then raised, and that end of the craft is moved 5 feet toward the opposite shore. The spuds, which are operated by hand winches, are next lowered, after which those on the opposite end are raised and that end is moved 5 feet. Another row of twenty holes is then started. Repetition of this procedure produces a pattern of holes on 5-foot centers. If it is desired to space holes in any row on 10-foot centers, this can be done by using alternate drills only. After the boat has worked across the full width of the channel, it is dropped downstream a distance of 5 feet in excess of its length, and another crossing is begun.

SHARPENING STEEL

Hollow, round steel of 1¼-inch section is used in lengths up to 22 feet, which is the longest the drill towers of the "Hornet II" will accommodate. Bits are all of 2¼-inch gauge, and in most cases one steel suffices for the drilling of an entire hole. The average depth of hole is 7-8 feet. The picture shows a bit being forged in a No. 50 sharpener that is part of the blacksmith-shop equipment on the drill boat.

Holes are loaded through the sand pipes as soon as they are drilled, and are wired for shooting. Blasting is not done, however, until fifteen or twenty rows of holes have been completed. The explosive used is Hercules and duPont 50 per cent gelatine dynamite. A day's supply is carried in a small barge that is towed behind the drill boat. A powder magazine is maintained in the hills near the job, and its stock is replenished as required by truck deliveries from the Birmingham area. Current for blasting is furnished by a 5-kw. lighting plant aboard the *Hornet II*. It is capable of detonating 400 holes at a time.

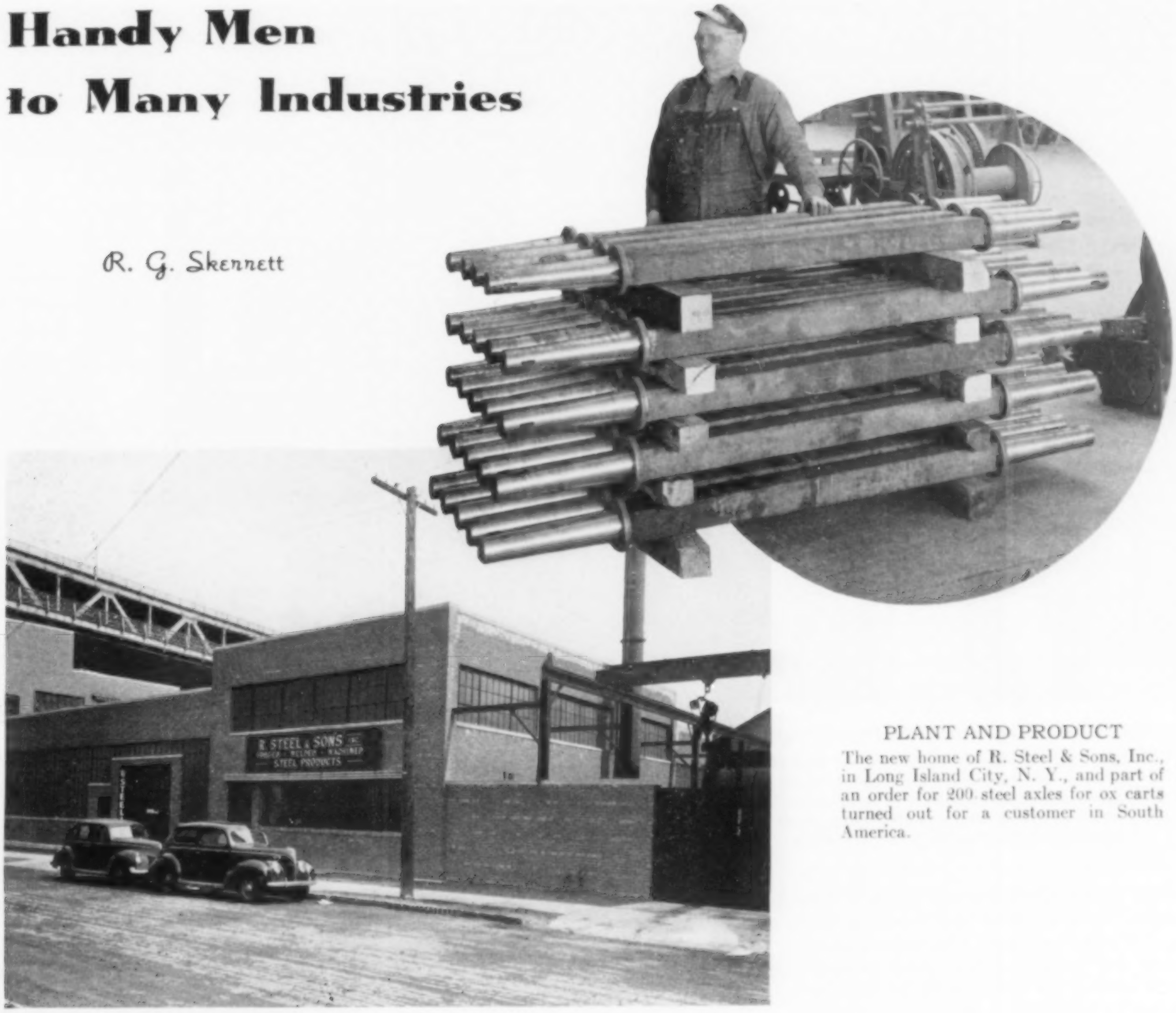
At the start of operations, 1,000 feet of channel was drilled and shot before dredging was begun, and the work is scheduled so that the drill boat stays well ahead of the other floating equipment. Dredging is conducted in a downstream direction. The dredge boat *LaSalle* is steam operated and provided with Osgood machinery. It has two 27x27-inch spuds near the front end and a trailing spud at the rear, all power operated. Most of the excavating is done with this dipper-bucket unit. Cleaning up of the bottom is done by the derrick boat *Minneapolis* which is provided with a clamshell bucket. Its machinery is of American Hoist & Derrick Company manufacture. It is possible to dredge at any depth down to 16 feet. Anything deeper imposes too great a strain upon the dipper stick of the *LaSalle*. That depth corresponds to a flow of 60,000 second-feet of water, which was the volume that caused the suspension of activities in February. With such a volume of water the velocity of the river below the dam reaches 4 or 5 miles an hour.

The excavated material is loaded on to the three steel barges and towed to the areas of disposition. The barges are not equipped with sideboards and each one will handle 100 cubic yards of material, which is the equivalent of approximately 225 tons. The rock used for riprapping is all of selected sizes.

Mr. A. F. Johnson, president of the Al Johnson Construction Company, is general manager of the work described. A. M. Thompson, president of the LaCrosse Dredging Corporation, is assistant manager. R. E. Englehart is superintendent. H. W. Gustafson is office manager, and F. T. Matthias is engineer. The operations are under the direction of the River Channel Improvement Division of the TVA Construction Department. Verne Gongwer is project engineer for the Authority, and J. C. Nowell is project design engineer. H. R. Johnston is civil engineer in charge of the dredging at both Pickwick Landing and Guntersville dams, and J. C. McCraw is assistant civil engineer.

Handy Men to Many Industries

R. G. Skennett



PLANT AND PRODUCT

The new home of R. Steel & Sons, Inc., in Long Island City, N. Y., and part of an order for 200 steel axles for ox carts turned out for a customer in South America.

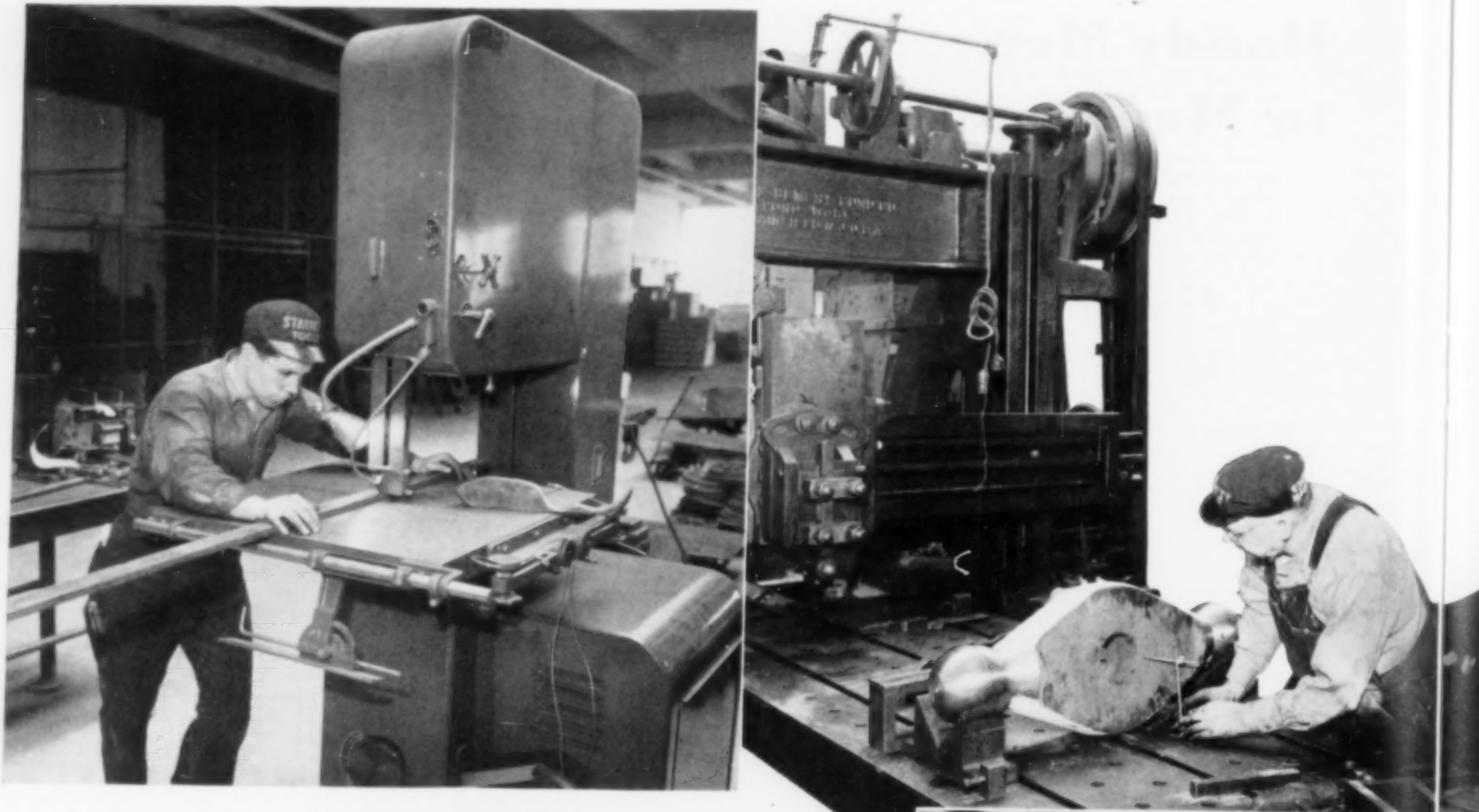
WHAT the resourceful country mechanic or the equally versatile village blacksmith may have done for you in a pinch, a plant in Long Island City, N. Y., is doing daily in various ways for scores of industrial enterprises, large and small, in the so-called Metropolitan zone. To be specific, we refer to R. Steel & Sons, Inc., a family firm that operates a combined forge and machine shop that is equipped to give helpful service quickly.

R. Steel & Sons, Inc., is a closely knit organization that is headed by Reginald Steel, the father of the family. Reginald Steel was born 70-odd years ago in the north of England, and as a young man of 22 years he came to the United States because he believed the New World had more to offer him than the land of his birth. He had the inbred gift of craftsmanship, and in due course became recognized as a first-class blacksmith and as an especially skilled worker in iron and steel. In the early "eighties" he was employed by the old Rand Drill Company, in New York City, and while with that concern he forged many a piston rod that was required to stand up under hard and exacting service in the rock drills of that time.

Year by year Reginald Steel ripened in experience and in his ability to deal with the different practical problems of his trade. When his two boys had passed through high school he sent them to college for engineering training; and after they were graduated and had worked in certain steel plants, then they took their places beside him in a company of which he is president. In 1922 the father and the two sons organized their own company under the name which it has since borne. In the years that have followed, R. Steel & Sons, Inc., has won a reputation for work well done, and done with all practicable dispatch. Strictly speaking, it operates what is commonly known as a jobbing shop—a type of plant that is of far more importance than most of us probably realize.

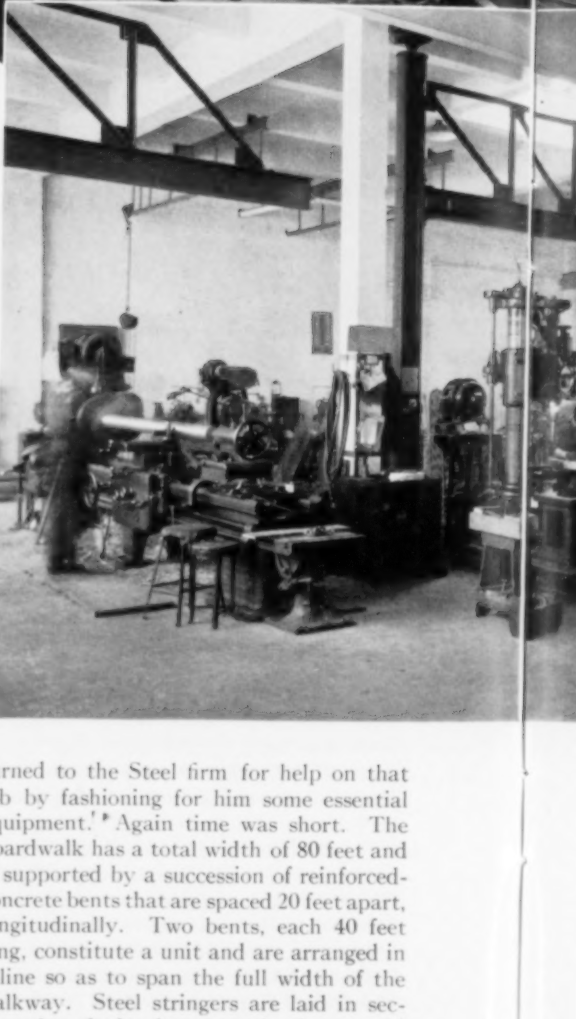
In this day of machinery, which is depended upon for many purposes and invariably to save time, its prompt repair when something goes wrong is usually a matter of urgency. It is not always feasible to get the replacement part from the manufacturer because of his remoteness from the point of use. Again, need may arise for equipment that cannot be purchased in the open market, or situations may develop that can be met effectively only with apparatus or rigging that can be produced in a jobbing machine shop or forge shop properly manned and outfitted for such work. Speed and good workmanship are essential; and, in addition, a problem may be presented that calls for originality and the gift of designing in order to deal with it to advantage. It is in services of this varied nature that R. Steel & Sons, Inc., has won for itself the commendations of numerous customers who are responsible for the by-word, "Try Steel: he will do almost anything."

How true the foregoing saying is may be confirmed by a glance over the comprehensive list of the firm's customers within the scope of the country's greatest city. Among these are steel and electric companies, motor-truck builders, fabricators of rubber, makers of centrifugal apparatus for sugar



SKILLED WORKMEN

The band saw shown above can cut steel of considerable thickness into any desired pattern. It is one of the most useful machine tools in the shop. In the picture at the right, above, a machinist is at work on an "equalizer" for a large dredge. This part, which was made from a steel forging, holds the dredge ladder and imparts to it the weaving motion required in its operation.



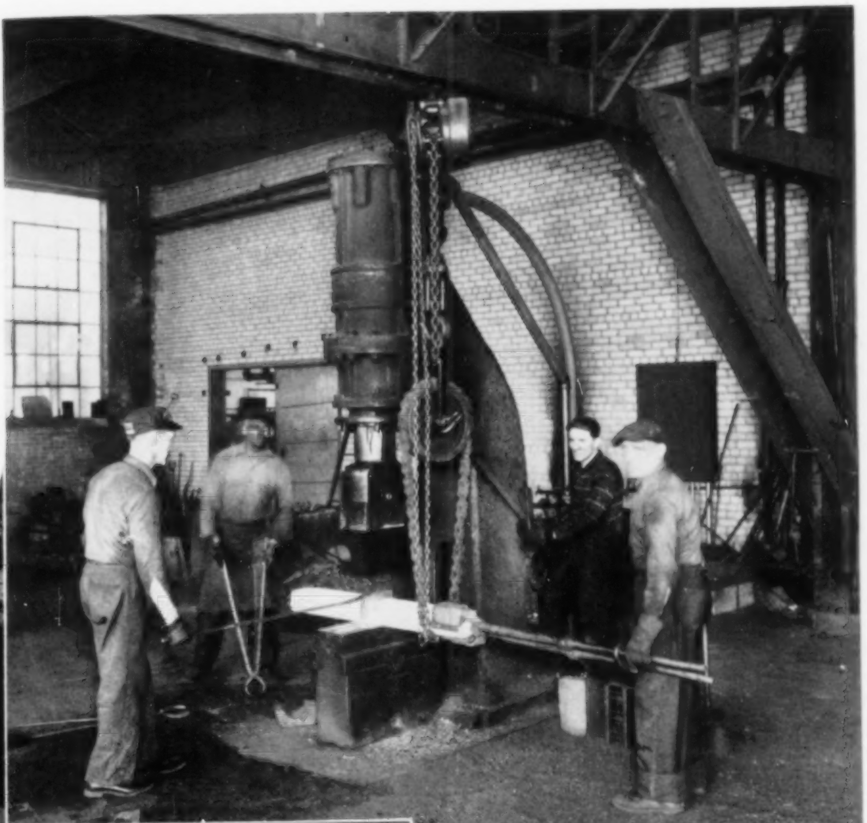
mills, tunnel drivers, bridge builders, fire-engine manufacturers, large dredging concerns, a can company, a big stone-cutting yard, and various engineering and construction enterprises doing work of different kinds on large undertakings.

The diversity factor stands out in the firm's business. For example, one sees the forge shop and the machine shop at work on a set of tough tungsten-steel teeth for a dredge that is engaged in biting into and excavating subaqueous coral rock in Bermuda. In the machine shop there is now nearing completion half of an order for 200 axles that are being fashioned from forged-steel billets 4 inches square in cross section. They are for ox carts used in moving lumber from the depths of the forests of Paraguay to the rivers by which it is rafted down to a seaport for shipment abroad. The carts have wheels 10 feet in diameter, and they are capable of carrying over rough roads great square-cut timbers of such heavy native hardwoods as petereby, lapacho, jacaranda, and cedron. Steel axles have been found better suited than the wooden ones that were used for this rugged and toilsome work for many years. The immediate customer is an exporting and importing house identified with South American trade, and this order is but one of many contacts that R. Steel & Sons, Inc., has with other countries.

The firm was the first to build roller-bearing sheaves for heavy hoisting in the Metropolitan zone—a type of power saver that is now being used extensively. This is merely an example of its alertness. In the recent past the organization constructed a large number of power-driven winches for handling the lifeboats of a big ocean-going liner. The winches are designed to meet present-day requirements, especially in getting loaded lifeboats away from a gravely damaged and possibly sinking vessel.

The site that is now occupied by the New York World's Fair was formerly a series of vast ash dumps and an expanse of swampland. After it had been graded for the present purpose, it was necessary to underpin all the big exhibition buildings, as well as the Trylon, Perisphere, and the Helicline of the Theme Center with thousands of timber piles, many of them 100 feet long and driven deep into the underlying ground. The fabricated steel leads that were used for guiding the long piles when handled by the various pile drivers were produced in the plant of R. Steel & Sons, Inc.

Only a short while ago, the successful bidder for the contract of shifting 3,800 linear feet of Coney Island's famous boardwalk 500 feet farther back from the water's edge so as to widen that popular and often densely crowded beach for the bathers turned to the Steel firm for help on that job by fashioning for him some essential equipment. Again time was short. The boardwalk has a total width of 80 feet and is supported by a succession of reinforced-concrete bents that are spaced 20 feet apart, longitudinally. Two bents, each 40 feet long, constitute a unit and are arranged in a line so as to span the full width of the walkway. Steel stringers are laid in sections lengthwise between the bents and



FORGING HAMMER AND MACHINE SHOP

One of the four air-operated forging hammers (left) that were built in the shop and that are used there. Its ram weighs 1,500 pounds and operates with a 27-inch stroke. The machine shop (center, below) includes sufficient equipment to handle a wide range of work.

carry the plank decking. Each reinforced-concrete bent is composed of a massive top beam poured integrally with four equally spaced columns each of which is long enough to penetrate the sandy beach from 30 to 40 feet.

When the bents were first placed, the columns were sunk to the prescribed depth by a jetting process; and to salvage them so that they can be used again in the shifted structure, water jetting is being employed to release the grip of the sand—to make it possible to withdraw each bent in its entirety without damaging it. Each weighs 18 tons, and the contractor's need was a rigging that would sustain that load while the sand was being washed away from around each column. That was not all. It was necessary that the rigging be designed so as to grip the bent where it was strongest—that is, at the tops of the columns where it would distribute the pulling and lifting stresses so that no damage would be done by overloading the intermediate sections of the top beam.

It was on a Friday that the contractor sought the aid of R. Steel & Sons, Inc. He said he would like to have the rigging on the following Monday; but when he was told that that would be impossible, he gave the firm a week in which to turn it out in view of the fact that the apparatus had to be planned before it could be constructed. Even so, the equipment was ready for delivery one day ahead of the prescribed time; and since then it has met every requirement in service. The work being done by it includes lifting complete, assembled sections of stringers and moving them to the new location.

The company specializes in the building of forging hammers of its own design. They are of the single-column, open-frame type, having a ram that weighs 1,500 pounds and operating with a 27-inch stroke. They are similar to the units in its own forge shop, which can handle steel billets that are round or square in cross section and range from a maximum of 10 inches downward. Much of the work in the plant is devoted to the making of replacement parts for large dredges, and this utilizes the resources of both the forge and the machine shop. Otherwise, the plant is kept busy in meeting unforeseen demands of numerous kinds, which usually call for prompt performance. Many of them present some difficulties, and the problem is to adapt the available equipment so as to deal with them. Here is where the versatility of the management and the skill of the operatives come into play. As the vice-president of the organization, R. A. Steel, expresses it: "The customer's trouble becomes our trouble; and when we get the work, the first thing is to decide how to do it, and then to do it fast enough to satisfy ourselves."

The present plant of R. Steel & Sons, Inc., is a recently erected structure that was planned so that its two main departments of machine shop and forge shop would afford space for further expansion. There are two 3-ton traveling cranes that run from front to back of the long central bay of the machine shop and that can handle a load of 7 tons when operating together. There also are a considerable number of stationary cranes carrying trolley chain hoists that serve to lift materials and parts to and from the various machines. The machine shop is equipped with diversified units such as drill presses, planers, lathes, etc., capable of taking care of any job that is likely to come in. One of the most interesting of the machine tools is a band saw that is used for cutting miscellaneous shapes, for making square slots, etc., in steel an inch or more in thickness. It is the means of doing nice and otherwise difficult work quickly.

In the adjoining forge shop, where much heavy work is done, the outstanding equipment consists of four air-driven forging hammers and of three oil furnaces the burners of which operate under low-pressure air. In addition, there are four regular coal-burning forges for heating metal that is to be worked by hand. The reasons for driving the forging hammers with compressed air instead of steam is explained by R. A. Steel as follows: "We have found that compressed-air impulse gives a much snappier blow than it would be possible to obtain with steam, and by the use of compressed air, the troublesome condensate always associated with steam is avoided. Dripping condensate, when falling upon brightly heated metal, is likely to cause scale to fly from the piece being worked, and that scale is a menace to the eyes of the workman. By operating our hammers with compressed air we don't have to worry in cold weather, especially when the shop is closed down overnight or during a weekend. Freezing of the steam lines or condensate in the hammer cylinder is thus effectually prevented.

"Formerly, each hammer had its oil cup; but we have learned that we do not have to lubricate our hammers in that way. Instead of filtering the air as it comes from the compressors, we allow it to carry to the hammers whatever oil it may have in suspension when it leaves the receivers, and even though the quantity that reaches them is small, still it is sufficient to keep the pistons properly lubricated. Of course, we drain both water and oil from our two outdoor receivers often as a safety precaution. We find compressed air not only economical but also more satisfactory than steam for this work in the forge shop."

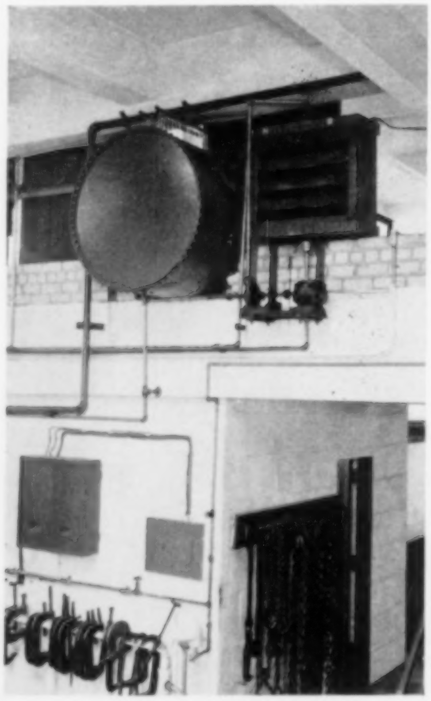
Compressed air is used in the machine shop to operate pneumatic grinders and riveting hammers. It is also employed in cleaning the various machine tools. But the primary purpose of the compressor plant is to furnish motive energy for the four hammers in the forge shop, and the volume of air required there depends upon the number of hammers in service. To take care of this varying demand, and to assure sufficient air at all times, the plant is provided with two Ingersoll-Rand 14x12-inch Class ER units. They are hooked up in parallel, and discharge into the single line that carries the compressed air to the two interconnected receivers. The air is maintained at a pressure of 110 pounds per square inch in the receivers and is delivered to the forging hammers at a working pressure of 100 pounds per square inch. One of the compressors is driven by a 75-hp. motor and has a piston displacement, when running at 210 rpm., of 480 cfm. The other machine, which is also belt driven but by a 100-hp. motor, operates at 275 rpm. and has a piston displacement of 628 cfm.

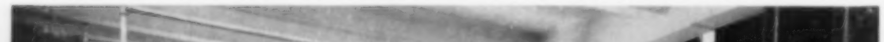
In the T-arrangement of the piping by which the two compressors deliver to the single line running to the receivers, there is a valve for each unit by which one or the other may be cut off. Likewise, interposed between the cylinder of each machine and its associate cut-off valve there is a safety valve. The purpose of this is to provide relief should the compressor be started before the cut-off valve is opened to permit the compressed air to flow on to the receivers.

Cooling water for the compressors is used over and over again, and the city supply is drawn on only to make up for any loss due to evaporation. Circulation between the machines and an elevated supply tank, which is about 12 feet higher, is maintained by means of a small motor-driven centrifugal pump that transmits the hot water from the compressors to a unit heater which is really operated as a cooler and serves to lower the temperature of that water by fully 10°F. If it were employed as a heater, steam would be passed through it and air would be blown over and from it by a small fan. In this case, however, the hot water from the compressors goes through the unit and the circulating air cools it, after which it is fed to a spray pipe that drops it into the storage tank. From there the water flows by gravity down into the circulating system. The arrangement has been found to be efficient and a money saver.

By having two compressors of the rated capacities already mentioned, both may be run simultaneously when the need of air calls for their united services; and when the operation of one unit suffices, then the other becomes a standby. At all times, the cost of supplying air can be held down within economical limits. The compressor intakes have their upper ends above the roof of the building and pass the air through filters instead of directly to the machines. They are arranged with offsets, thus leaving the space above the compressors clear so that a crane can be swung into position above them either to service or to move one or the other of them bodily.

It would be possible to continue at length about the plant's activities; but enough examples have been cited to emphasize the adaptability of such a jobbing shop. The executive officers of R. Steel & Sons, Inc., are: Reginald Steel, president; R. A. Steel, vice-president; and Thomas Steel, secretary and treasurer.

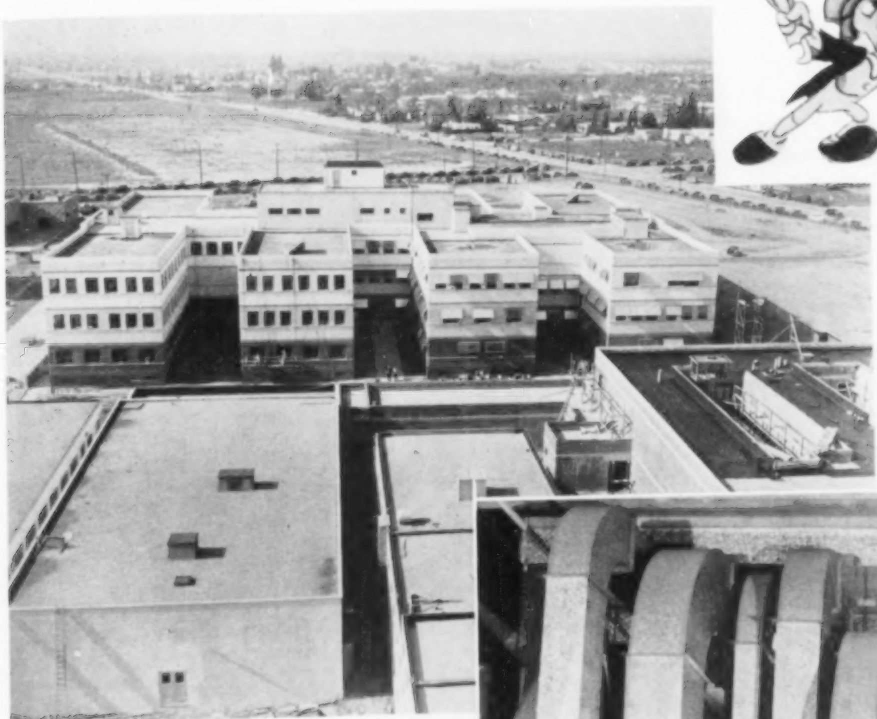




COMPRESSORS AND COOLING-WATER SYSTEM

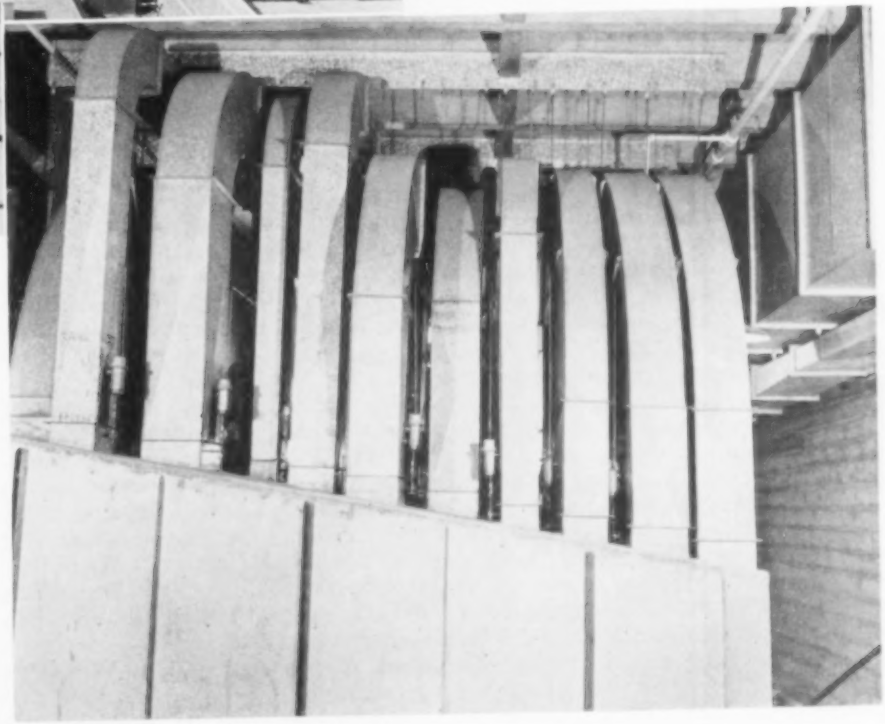
The two compressors pictured at the left furnish air for operating forging hammers and for numerous other purposes. Cooling water for these units is circulated in a closed system (above) that permits it to be used over and over with only small additions to compensate for evaporation. Hot water from the compressor jackets is lifted by a small centrifugal pump and sent through the coil of a unit heater that is operated as a cooler. From the cooler it passes on to jets that spray it into a storage tank from which it flows to the compressors by gravity.

Walt Disney's Gang in New Home



THE NEW STUDIO

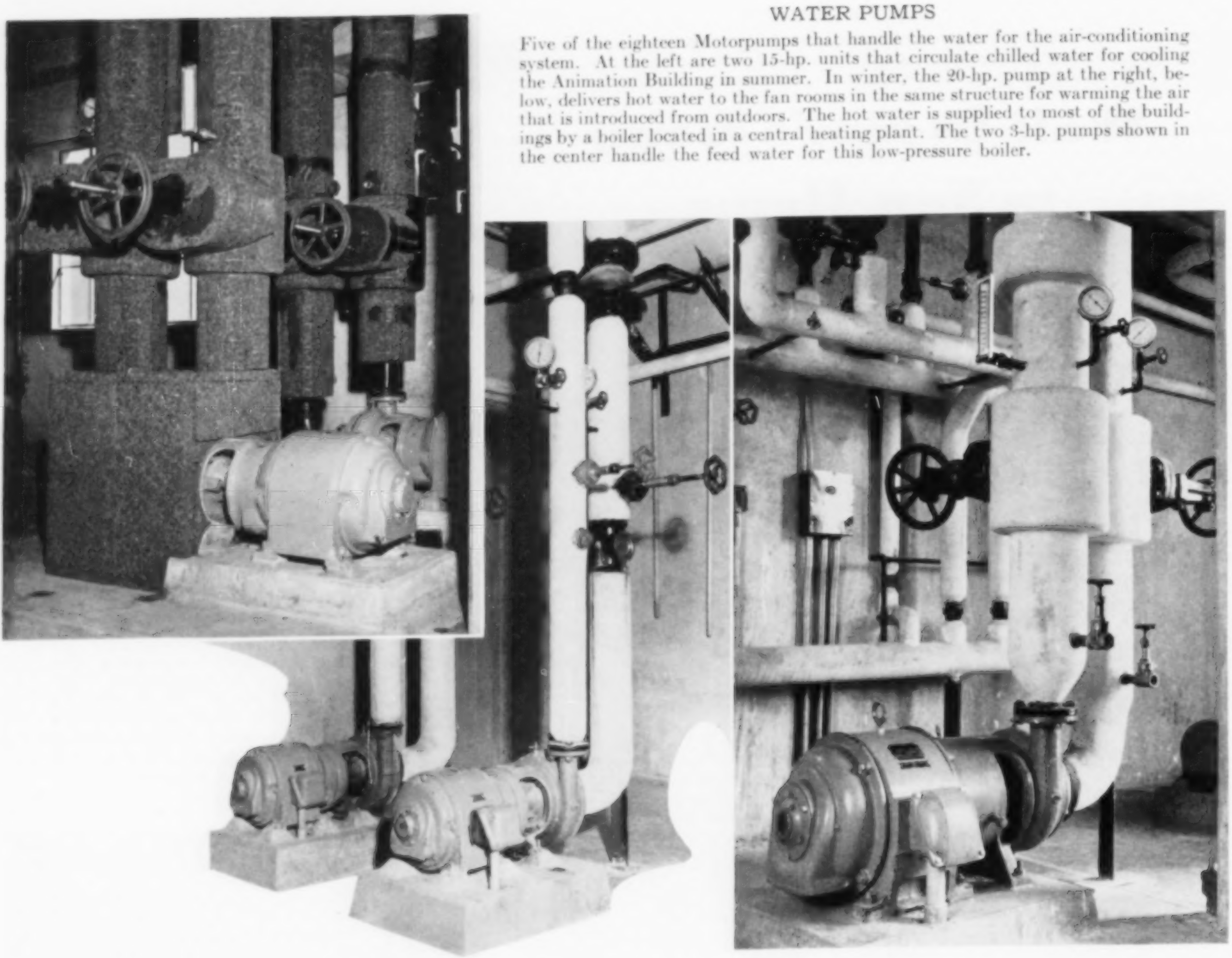
General view (left) of the group of buildings in Burbank, Calif., that will henceforth house Walt Disney Productions. The building in the middle distance, with eight wings projecting from a central structure, is occupied by the 900 artists who animate the characters in the world-popular Disney films. The entire plant is air conditioned. The picture below shows one of the fan rooms with the numerous ducts that supply fresh, conditioned air to a part of the Animation Building. There are 160 of these ducts in the structure.



FOUR and a half miles from the center of Hollywood, Calif., in the warm San Fernando Valley, lies a new motion-picture studio. No glamour movie queens, no handsome leading men are seen in the halls of this newest of cinema cities. Yet no other motion-picture studio can boast of being 100 per cent air conditioned: few structural units approach it in the luxury and magnitude of its buildings and equipment. It is the home of Walt Disney and his gang, creators of Mickey Mouse, Donald Duck, Pinocchio and Jiminy Cricket, and exemplifies the most modern trend in the construction of its buildings and of its air-conditioning system.

Three things are responsible for the building of the new home for Walt Disney Productions. One—the most important—is that Disney has always insisted on the best environment for his employees. Second, ever since the phenomenal success of *Snow White*, Disney has realized that his organization has become "big business," and that such a business needs a proper setting to keep in step with the rapid growth of animated pictures. Third, he wanted to increase speed of production to a point where it would take only a year to make a full-length picture, instead of the two and a half required for *Pinocchio*. This was impossible in the old studio.

As a result, there was constructed, on a 51-acre tract near Burbank, a 21-building city, complete in itself, with paved streets, curbs, street lights, sewer and storm drainage system, fire equipment, restaurant, hospital, and recreation center—all serviced by the largest air-conditioning plant west of the Mississippi River. Each unit was designed to solve its own problems peculiar to the making of animated pictures. For example, one of the structures, known as the Animation Building, houses some 900 creative artists who "animate the



WATER PUMPS

Five of the eighteen Motorpumps that handle the water for the air-conditioning system. At the left are two 15-hp. units that circulate chilled water for cooling the Animation Building in summer. In winter, the 20-hp. pump at the right, below, delivers hot water to the fan rooms in the same structure for warming the air that is introduced from outdoors. The hot water is supplied to most of the buildings by a boiler located in a central heating plant. The two 3-hp. pumps shown in the center handle the feed water for this low-pressure boiler.

characters" in Disney pictures. With a total floor space of 150,000 square feet, it has eight wings extending four on each side from a central tier, and each wing is conditioned by its own air-conditioning plant.

Another example of the type of structure required at the studio is the Camera Building, where cleanliness is of prime importance. This is due to the fact that a single particle of lint or dust on a painting might, upon being photographed, produce magnified effects that would be harmful to the finished picture. Thus, besides keeping floors waxed and equipping operators with lintless clothing, there is a dedusting chamber where any loose particles on the clothing of the operators are blown off by high-velocity air jets and drawn down through a grating in the floor. From there, on its way outdoors, the air is routed to cool the motor-generator sets which supply the cameras with electricity.

In the case of the camera rooms, engineers were faced with the task of removing heat without the aid of drafts, because some of the cameras use more than 70 kw. of lighting energy each. This means the production (through lighting energy) of some 240,000 Btu's of heat per hour, the neutralization of which by means of ice would necessitate the melting of about 40,000 pounds every 24 hours. This problem was met by installing exhaust hoods to draw off air at the points of heat concentration, and by multi-outlet air distribution.

The General Electric air-conditioning system which is now in service at the Disney plant is fundamentally of the central-plant type. Wells drilled on the grounds furnish water at a temperature of 67°F., which preheats the entering air on cold days and precools it on hot days. Incidentally, this cuts down operating expenses considerably, because the natural water supply has a cooling capacity that is equivalent to approximately 1,000 tons of refrigeration.

Refrigerated water for air-conditioning the main group of buildings in summer is provided by a 600-hp. multiple-condensing unit plant: during the winter months the same structures receive heat from two central, 190-hp. boilers. The smaller, isolated buildings have independent air-conditioning systems—all others taking heated or cooled water from the central heating-and-refrigerating plant.

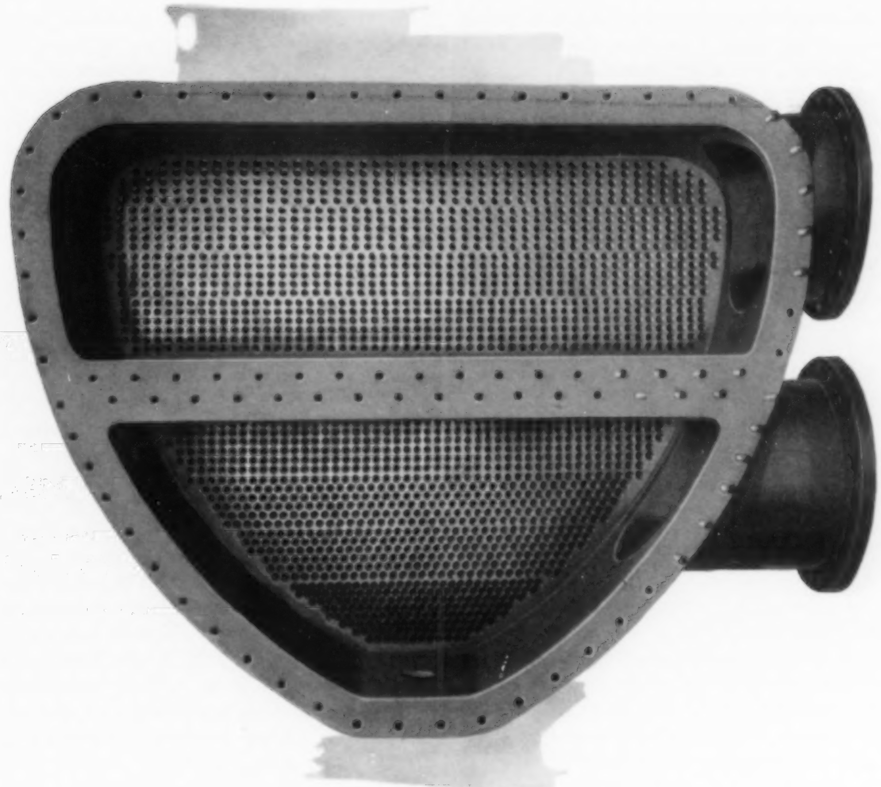
A striking fact about the air-conditioning system is that 100 per cent fresh air is used well-nigh throughout the entire studio, with no room air recirculated back into the rooms. Using the heating or cooling effect of the water supplied by the central plant, individual air conditioners serve each building. They condition the air at a single point—or at several load centers—in each structure, and in most cases are located in the basement. From there the air is conveyed to the various rooms through ducts. In the winter the air is heated to the required temperature, humidified, and carefully cleaned. It is kept in motion, and a properly proportioned volume of fresh air is introduced. In the summer the same system furnishes cooled, dehumidified air. Installed in the central plant and at the points of the various air-conditioning systems in the studio are eighteen Ingersoll-Rand Motorpumps. These single-stage units, with pump and motor in one housing, range in size from ¾ to 20 hp. each, and were selected for their compactness and simplicity.

The only complaint that has yet been heard has come from Donald Duck, who is upset because he can't open any of the windows in the studio and stick his head out when he feels a good squawk coming on!

Steam Condensers

PART 3

A. D. Kann



TUBE SHEET AND WATER BOX

Tube-sheet layout and water-box arrangement of an Ingersoll-Rand single-pass surface condenser. Gradual reduction of the steam-flow area is obtained by the use of a heart-shaped shell and differential tube spacing. A correctly proportioned path for the decreasing volume maintains an active flow of steam over all the tubes. The water box is divided into two sections, and duplicate water nozzles permit the independent operation either of the upper or lower half of the condenser. This makes it possible to clean the tube bank in one half while that in the other half remains in service. The water box has the appearance of the inlet-outlet end of a 2-pass condenser, without the "split-for-cleaning" feature. An external air cooler is used with this condenser.

Vacuum Heater

EVIDENTLY, a simple thermostatic air valve is no good for getting air out of a shell when the pressure in the shell is less than atmospheric. Such a shell cannot be operated for any length of time under vacuum without some form of apparatus that will pump out the air which enters with the steam or through leakage.

Suppose a supply of 72°F. water is to be heated to 142°, as in the problem discussed on pages 6129-6130 in the April issue. Obviously, it is not necessary to use 212° steam: cooler steam at, say, 160° would do the job. Steam at 160° and at an absolute pressure of 4.74 pounds per square inch (approximately 20.4-inch vacuum) is obtainable, for example, from a "bleed" stage of a condensing turbine.

It is apparent that a water heater, that is designed to be supplied with steam at less than atmospheric pressure, cannot be self-venting. Air is bound to get into it. As the steam condenses to water in the heater, the air will be left behind and, gradually increasing in quantity, will occupy space to the exclusion of live steam, thereby blanketing the heat-transfer surface. The pressure of this accumulation of air can never exceed the pressure of the steam entering the heater shell. Consequently, there is nothing to expel this unwelcome fluid from the shell against the external atmospheric pressure. It is easily seen that the unit will finally become completely filled with air, rendering it useless as a water heater. Steam will not diffuse through stagnant air with sufficient rapidity to account for any material flow of steam or transfer of heat.

Effect on Size

Before considering how to dispose of the air, it might be well to examine the new conditions in the light of the factors that have already been discussed in order to determine what proportions the heater must have. Again, following the same procedure as before:

EXAMPLE 3

Steam temperature = 160°F.
Cold-water temperature, inlet = 72°
Initial temperature difference 88°

As we know that the final temperature is 142°,

$$TR = 142 - 72 = 70°$$

$$R = \frac{TR}{TD} = \frac{70}{88} = 0.795$$

Heat added to water to raise 1000 gpm. from 72° to 142°

$$= 1000 \times 8.33 \times 60 \times 70 = 35{,}000{,}000\ \mathit{Btu./hr.}$$

According to the steam tables, the latent heat of steam at 160° is 1,002 Btu. per pound, say, 1,000 Btu. Therefore

$$\frac{35{,}000{,}000}{1{,}000} = 35{,}000\ \mathit{lb./hr.\ of\ steam}$$

to be supplied for heating the water. The condensate obtained will be approximately 70 gpm.

Further, assuming $\frac{3}{4}$-inch No.18 Bwg. brass tubes and a water velocity of 6 feet per second, we find that the over-all heat transfer coefficient will be about 570 Btu. per square foot per hour per degree (Fahrenheit) mean temperature difference. This figure is based on an average water temperature of 123°. The logarithmic mean temperature difference is:

$$LMTD = \frac{70}{\log_e \frac{88}{18}} = \frac{70}{\log_e 4.89} \tag{4}$$

$$= \frac{70}{2.3 \log_{10} 4.89} = \frac{70}{2.3 \times 0.689}$$

$$= \frac{70}{1.585} = 44.2°$$

The required heat exchange surface is:

$$Surf. = \frac{35{,}000{,}000}{570 \times 44.2} = 1390\ \mathit{sq.\ ft.} \tag{5}$$

Comparing this figure with the area obtained in the first example, it will be noted that more than twice as much surface is needed to transfer the same amount of heat to the same quantity of water. This fact is attributable to

1- A much smaller *TD*, 88° vs. 140°
2- A much higher *R*, 0.795 vs. 0.5.

However, it might well pay an owner to spend the money for the larger equipment, because the "bleed" steam used for heating the water will earn a large percentage of its cost by producing useful mechanical energy in the turbine from which it is bled. The latent heat remaining in the steam and being profitably utilized in water heating would otherwise be wasted to the circulating water in the condenser serving the turbine exhaust. Consequently, there is a place for vacuum heaters, and many applications have been made. In all fundamental aspects, such a heater is analogous to a high vacuum condenser. Therefore, if we investigate methods for continuously purging the shell of a vacuum heater of air and other noncondensable gases, we shall have developed the equivalent of a standard surface condenser, as applied to prime movers.

Air Removal from Vacuum Vessel

Figure 10, on page 6133 in the preceding issue, shows how air can be automatically vented without loss of steam when the operating pressure in the shell equals or exceeds atmospheric pressure. When the internal pressure is subatmospheric and the automatic vent opens, air will rush in and place the shell under atmospheric pressure. As previously indicated, air is heavier than steam and tends to concentrate in the lower part of the shell. Therefore, the air offtake connection is usually made at or near the low point in the shell opposite the steam inlet and with the tube bundle intervening. A reciprocating vacuum pump can be, and in the past regularly was, used to pump the air out of the shell and to compress it to atmosphere. When the vacuum is low, that is, when there is a pressure equivalent to 8-10 inches of mercury in the shell and at the suction connection of the vacuum pump, a reciprocating pump is very effective. The specific volume of the air handled is comparatively low, the ratio of compression is low, and a pump of moderate size operating efficiently can economically handle the air load.

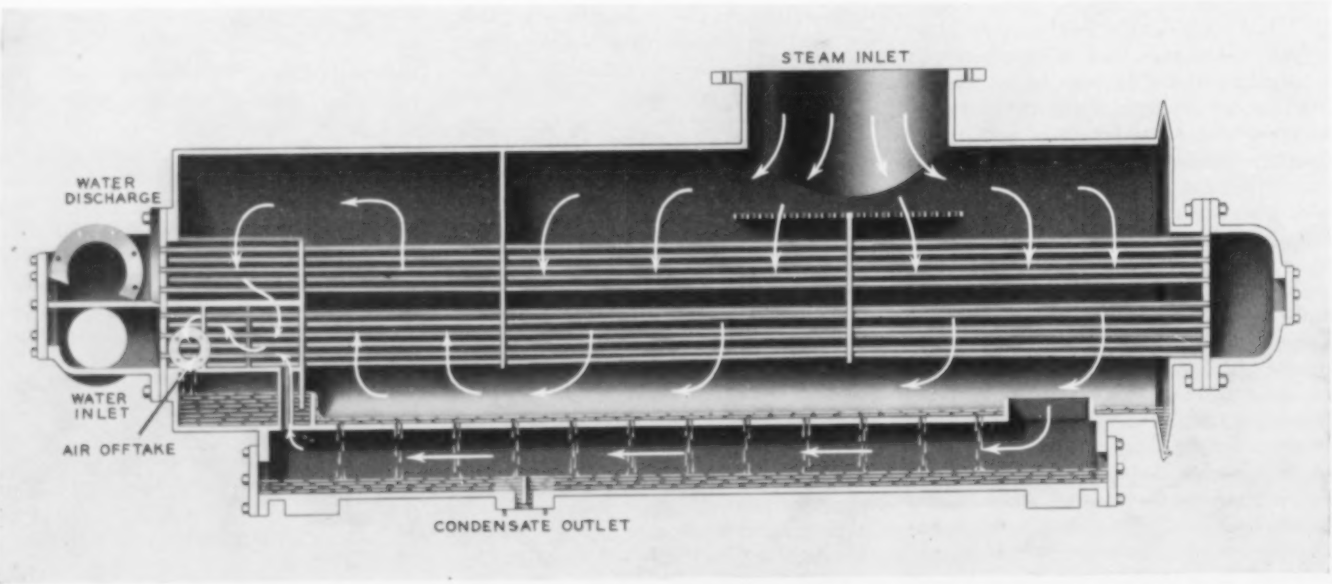
In a case like this, as applied to a "low" vacuum heater, the entering-water temperature is likely to be substantially lower than the steam temperature in the shell, and the air drawn off from the bottom will flow over the coldest tubes in the shell before reaching the air pump. This is an important factor, because contact of the steam-and-air mixture with these cold tubes tends to condense out of the moving stream a part of the residual steam mixed with the air, thus reducing the volume of the fluid (air-vapor) to be handled by the pump and, in turn, the power needed to run it. This favorable action grows in importance as the shell pressure is lowered (vacuum increased) and the specific volume of the air-vapor mixture is increased.

Size of Vacuum Pump

Let us assume the air leakage, in a typical case, amounts to 10 pounds per hour. If, as in the last example, the shell pressure is approximately 9.65 inches of mercury (Hg.), absolute, the specific volume of dry (steam-free) air at 160°F. is about 49 cubic feet per pound. If the vacuum pump could get dry air, it would have to have an actual capacity of 490 cfh., or 8.1 cfm., at the intake. However, steam is always associated with the air withdrawn from the shell of a heater or condenser.

The amount of saturated steam associated with a given quantity of air varies with the temperature of the mixture at any stated pressure. The partial pressure of the steam will equal the pressure of saturated steam at the temperature corresponding to that of the mixture. If the temperature of the mixture is the same as that of the condensing steam in the shell, the proportion of steam to air will be infinite and it would be impracticable to remove the air without taking all the steam along with it. Fortunately, as the air gathers it becomes subcooled to a point below steam temperature by direct contact with the cold tubes and even the cool wall of the shell. Where the pocket forms, the air will be subcooled somewhat, making it possible to withdraw it without taking fantastic quantities of steam along with it.

Let us suppose that with a steam temperature of 160°F. and water entering the tubes at 72°, the collected air is cooled to, say, 140°. At that temperature the saturated-steam pressure is 5.88 inches Hg., absolute, and the total (shell) pressure is 9.65 inches Hg. Deducting 5.88 from 9.65 leaves 3.77 inches Hg. as the partial air pressure. Then 10 pounds of air per hour becomes:



EFFICIENT SMALL CONDENSER

This cross section of a small 2-pass surface condenser illustrates several design features that contribute to high efficiency. Problems inherent to small condensers—such as extreme length of tubes in comparison with the size of the steam inlet, shallow tube bank, and the necessity of handling a relatively high percentage of air in the steam—have been recognized. Tight-fitting support plates guide the decreasing volume of steam through proportionately reduced flow areas. Ample velocity is thereby maintained to sweep air accumulations from the tubes and to assure a high average heat-transfer rate. Means are provided for keeping the condensate at steam temperature. The air cooler is built inside the shell at the inlet-water end, and provides several passes for the air-vapor mixture over the coolest tubes in the shell.

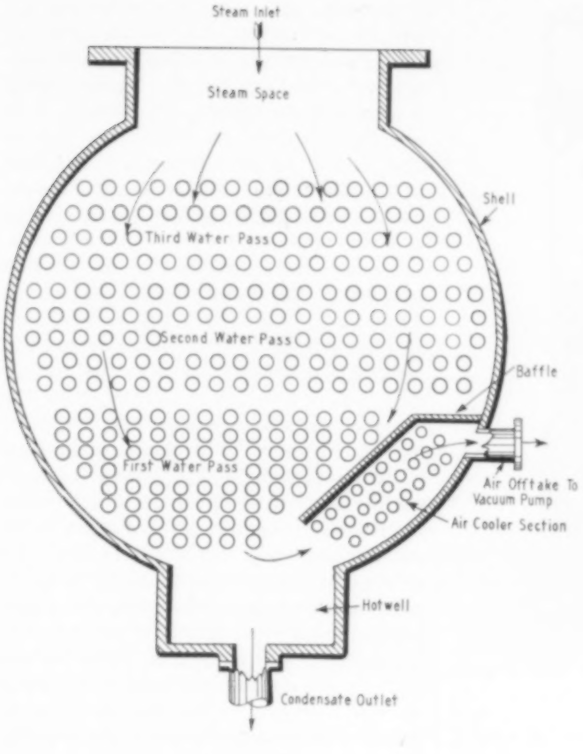


Figure 11

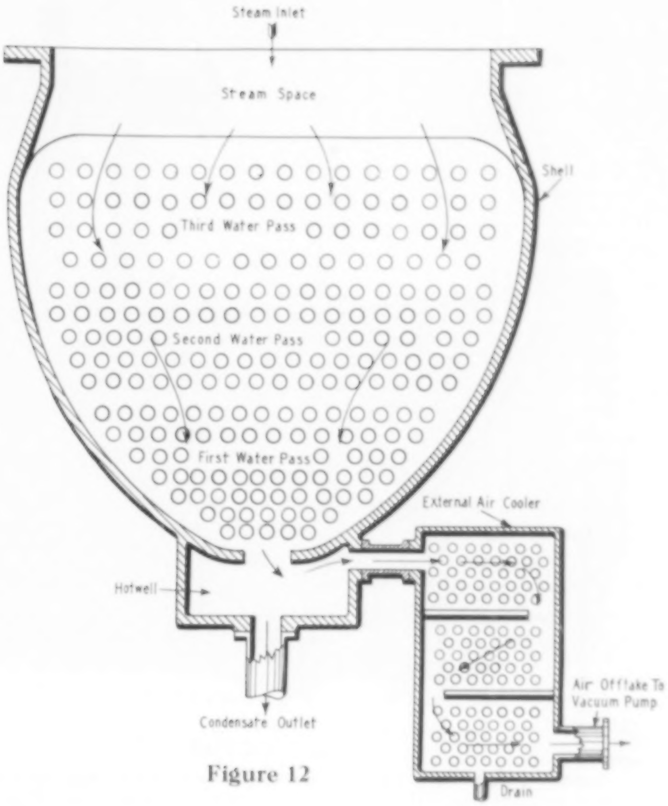


Figure 12

$$\frac{10}{60} \times 13.35 \times \frac{600}{530} \times \frac{30^*}{3.77} = 20\ cfm.$$

When the volume occupied by a gas (air) is calculated on the basis of its partial pressure, as in the case just outlined, the other component of the mixture occupies the same volume—not an additional volume. Therefore, 20 cfm. represents the total volume of the steam-air mixture at the total absolute pressure of 9.65 inches Hg. Saturated steam at 140° (5.88 inches Hg.) has a specific volume of 123 cf./lb., so there will be

$$\frac{20 \times 60}{123} = 9.75\ lb./hr.$$

of steam in the 20-cfm. mixture at the entrance to the vacuum pump.

If the partial steam pressure can be reduced to 3.45 inches Hg. by carefully arranging some cold tubes so that the air-vapor mixture will be subcooled to 120° rather than to 140°, the weight of the steam mixed with air will be only 3.5 lb./hr., the mixture containing 10 lb./hr. of dry air will be decreased to 11.8 cfm., and the capacity of the vacuum pump will need to be only 60 per cent as large as formerly. Realization of these fundamental laws of gas-vapor mixtures has prompted condenser manufacturers to pay considerable attention to the problem of air-cooling in an effort to minimize the size and the cost of the air-removal apparatus. Some of them build in the shell a segregated compartment to function solely as an internal air cooler. Others provide a separate or an attached external unit in which cross-sectional areas, mixture velocities, special tube spacing, and directed flow are all carefully utilized to effect maximum subcooling. External coolers are supplied with a by-passed portion of the entering cold water and are arranged so that it flows counter to the air-vapor mixture. Figures 11 and 12 illustrate the types mentioned.

It is apparent from the examples that have been cited that the physical dimensions of a vacuum pump to serve a heater are ordinarily not at all troublesome. One reason is that adequate air-cooling is readily effected because of the large temperature difference between the steam in the shell and the entering water. Another reason is that the comparatively low vacuum (moderately high absolute pressure) keeps the specific volume of the air, with its associated vapor, at a fairly low value.

Effect of High Vacuum on Air Removal

Evidently, as the absolute pressure in the shell is reduced, the specific volume will be increased. Furthermore, the available temperature difference will be lowered and, to obtain effective subcooling of the air-vapor mixture, it becomes increasingly important to incorporate an effective air cooler, as just described.

For condensers serving turbines, a shell pressure of 1 inch Hg., absolute, or 29 inches vacuum, is about the lowest ordinarily required. If the air-removal apparatus is to evacuate the shell satisfactorily at this operating point (a common design point for the evacuating equipment), it may be assumed that the mixture can be cooled 7.5° below the steam temperature of 79°, or to 71.5°. Under these conditions, again supposing that 10 pounds of air per hour is to be handled, we can evaluate the effect on the volumetric capacity of the air pump. At 71.5°, the partial pressure of the steam is 0.778 inch Hg., making the partial air pressure 0.222 inch Hg. (1.0 – 0.778) and

$$\frac{10}{60} \times 13.35 \times \frac{460 + 71.5}{460 + 70.0} \times \frac{30^{**}}{0.222}$$

$$= 300\ cfm.$$

The volumetric capacity for handling the same 10 lb./hr. of air has increased from 20 to 300 cfm., principally because the absolute pressure has been dropped from approximately 10 inches to 1 inch. The volumetric efficiency of a mechanical single-stage vacuum pump at 1 inch, absolute, also will have fallen off greatly. As a result, a 2-stage pump would have to be used, and, with a volumetric efficiency of something

---

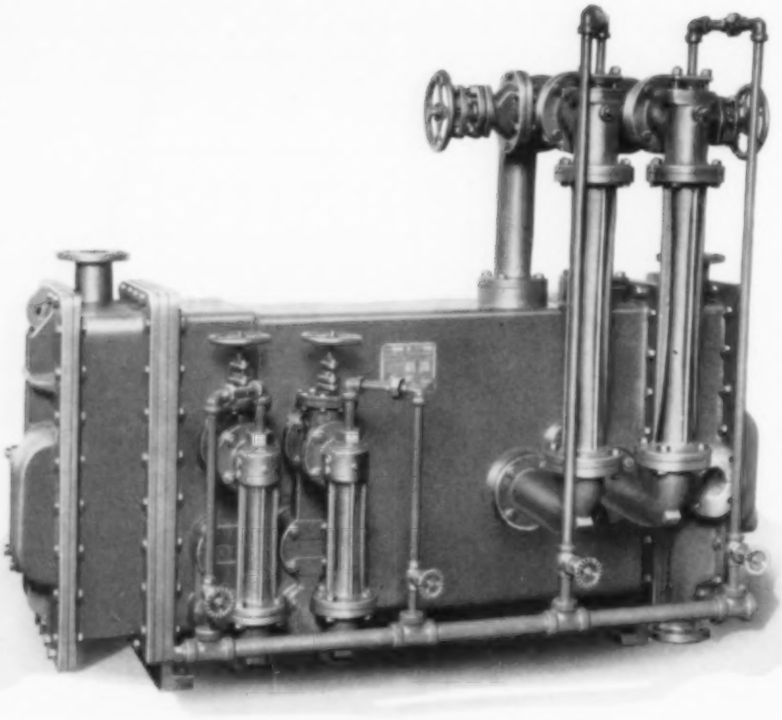
*Weight of air per hour = 10 lb.
Weight per minute = 10/60
Specific volume of dry air at 70° and atmospheric pressure = 13.35
Conversion to volume at 140° by multiplying by ratio of absolute temperatures

$$\frac{(460 + 140}{(460 + 70} = \frac{600)}{530)}$$

Conversion to volume at 3.77 inches Hg., absolute, partial pressure by multiplying by inverse ratio of absolute pressures

$$\frac{(30'' \text{ Hg.})}{(3.77'' \text{ Hg.})}$$

**See footnote in first column.



AIR-EJECTOR UNIT

Typical assembly of a 2-stage, twin-element air ejector, with an external air cooler, intercondenser, and aftercondenser combined in a single shell. This unit has tubular heat-exchange surfaces. Cold raw water is circulated through the tubes in the cooler section. Condensate is usually used in the inter- and aftercondenser sections in order to recover the heat in the steam required by the ejectors. Similar units without a precooler are used with condensers having internal coolers.

like 0.6, the piston displacement of the first-stage cylinder would have to be

$$\frac{300}{0.6} = 500\ cfm.$$

These figures give a clue to the situation that led to the development of steam-jet air ejectors for handling large volumes of air-vapor at extremely low pressure.

Steam-jet ejectors for this service are compact, involve no moving parts, and readily handle large volumes of highly attenuated gas. They have a further advantage in that it is not necessary to compress all the vapor associated with the air all the way to atmospheric pressure, as a large proportion of it can be removed in the intercondenser serving the first-stage ejector. Steam-jet air ejectors have gradually become standard air-removal apparatus for high-vacuum equipment where condensable vapors are present with the air. Air ejectors constitute a subject of considerable magnitude, and it would be out of place in this article to elaborate on them.

Condensate Removal

As has been shown, it is necessary continuously to pump the air out of a vacuum vessel. It is equally necessary to remove the condensed steam, for otherwise the shell would quickly fill with water. An open drain cannot be used because atmospheric air would rush in, flood the shell, and prevent entrance of the steam. An automatic trap cannot be employed because it would either permit air to enter or refuse to open against atmospheric pressure.

One expedient that can be resorted to where headroom permits, is to install a long, vertical drain pipe, with the lower end below the surface of water at an established over-flow level in a sump. If the vertical height of the pipe exceeds the distance through which the water in the sump will rise under atmospheric pressure against its exposed surface, air cannot enter the pipe and condensate can drain into it, displacing the water standing in it. This construction is called a "barometric drain" by reason of the fact that it is high enough to be sealed against air inflow by the water column resulting from barometric pressure on the water in the sump, as shown in Figure 13. The barometric method is commonly used for draining direct-contact condensers or heaters, and the term barometric condenser is derived from this feature.

Ordinarily, where a shell-and-tube vessel (surface type) is used, it is not permissible to install a long drain line with the equipment supported high above ground. If it can be placed so that the bottom of the shell will be a few feet above the foundation-floor level, as is the usual practice, some type of water pump has to be used to gather the condensate as it collects and to expel the water against external atmospheric pressure, plus whatever additional external head there may be. Such a pump, regardless of the type, is called a condensate-removal or hotwell pump. Reciprocating pumps may be utilized. Currently, it is well-nigh standard practice to use centrifugal pumps. In any event, the pump must be selected and installed with care if it is to operate successfully against the equivalent of a very high suction lift. In every case, the drain line, connected to the suction opening of the pump, must be of ample diameter to permit very low velocity and to minimize pressure drop in the suction piping. The pump must be located so that there will be a minimum head of about 2 to 3 feet of water in the pipe above the center line of the pump. Frequently, some form of float-actuated regulator serves to control the discharge from the pump to maintain a substantially constant level of water in the suction line under variations in flow. By taking these precautions, and by properly venting the casing and sealing the glands against inward leakage of air, the inflowing condensate, which is kept from flashing only by the residual net head of the water at the entrance to the impeller, can be handled without cavitation in the impeller. If cavitation occurs, or air leaks in, the pump may become air- or vapor-bound and fail to function. Nevertheless, in spite of

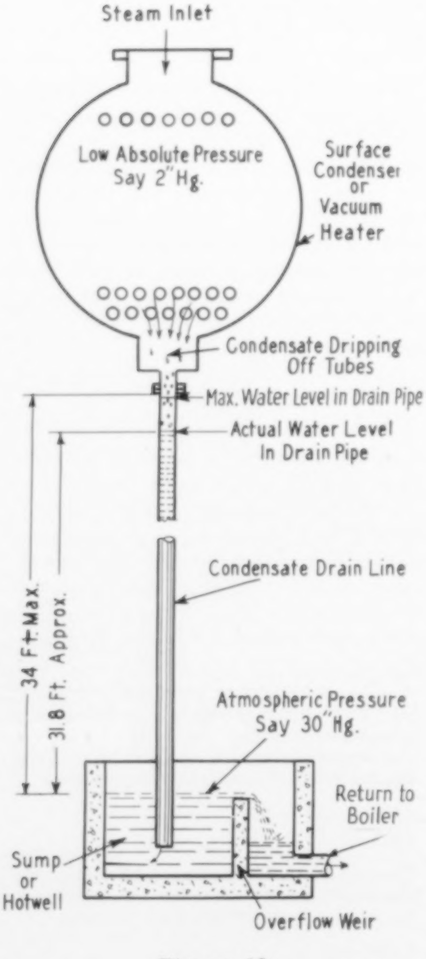
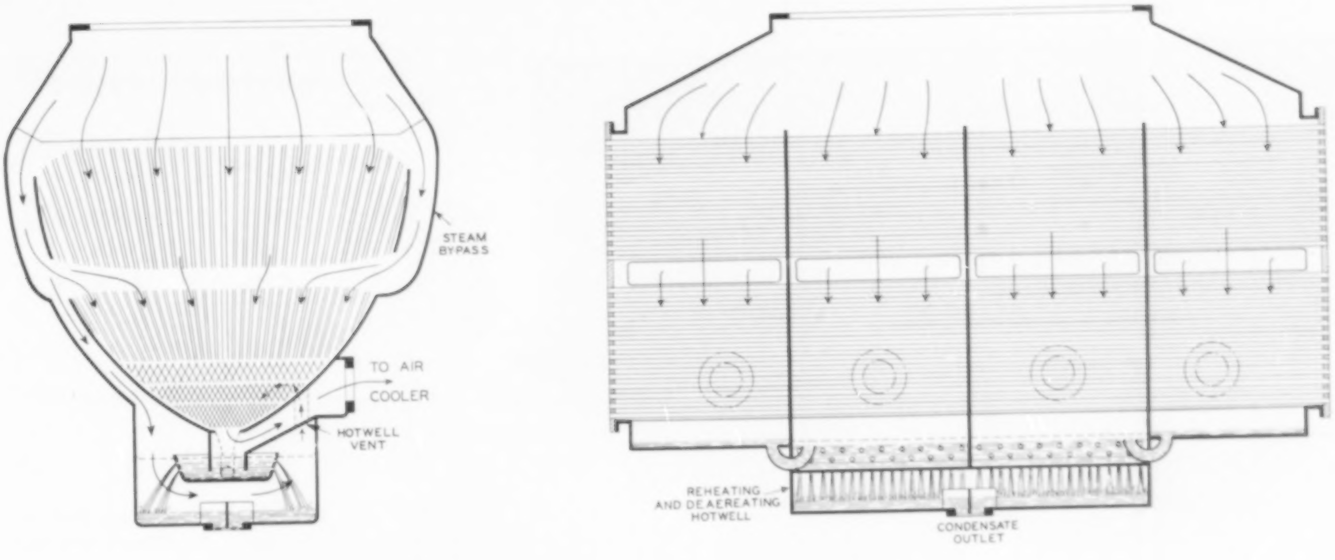

Steam Inlet
Low Absolute Pressure Say 2" Hg.
Surface Condenser or Vacuum Heater
Condensate Dripping Off Tubes
Max. Water Level in Drain Pipe
Actual Water Level In Drain Pipe
Condensate Drain Line
34 Ft. Max.
31.8 Ft. Approx.
Atmospheric Pressure Say 30" Hg.
Return to Boiler
Sump or Hotwell
Overflow Weir

Figure 13



SECTIONS THROUGH CONDENSER SHELL

The design features shown in these sectional views typify Ingersoll-Rand practise as applied to large surface condensers such as are supplied for turbo-generating units with a capacity of from 10,000 to 160,000 kw. Note the heart-shaped shell, differential tube spacing, and longitudinal control of steam distribution by means of separate air-removal connections to each section. Steam by-passes admit some of the steam to the lower tube bank. Condensate collects in a trough and is maintained at steam temperature by spraying it from there into the hotwell through steam.

these inherent problems, experience and improved engineering make it possible effectually to remove condensate from condensers when operating under the highest obtainable vacuums.

Condensers vs. Heaters

It has been seen that, fundamentally, a surface condenser is much the same as a shell-and-tube water heater. Practically, the actual physical differences between them are the result of their respective—

1- Operating pressure range (vacuum)
2- Available temperature difference
3- Method of operation
4- Criteria on which performance is judged
5- Economics.

Taking these factors in their order, we note:

1- That the steam pressure, even in a vacuum heater, is substantially higher than the 1 to 3 inches Hg. absolute pressure maintained in condensers serving steam turbines. Consequently, heaters do not have to be designed to handle great volumes of very attenuated steam with high efficiency.

2- The mean temperature difference and the initial *TD* are apt to be considerably higher in a vacuum heater than in a condenser. When this is true, the heater can be built with much less heat-transfer area (surface) than can a condenser of equivalent heat-handling capacity.

3- A heater is operated to raise the temperature of a certain quantity of water from some lower temperature to a specific higher temperature, taking as much or as little steam at a certain pressure as is needed to accomplish the work of heating the water. Sometimes a heater may be required to absorb as much heat as possible from the available steam flow, condensing all the steam and imparting either a variable temperature increase to a constant flow of water or a constant temperature increase to a variable water flow. This method of operation is analogous to that of a condenser in which all the available exhaust steam is condensed and a constant flow of circulating water is generally heated to a greater or lesser extent from a variable initial temperature. In this case the operating pressure or vacuum varies with the initial water temperature, quantity of water, and the amount of steam entering the shell.

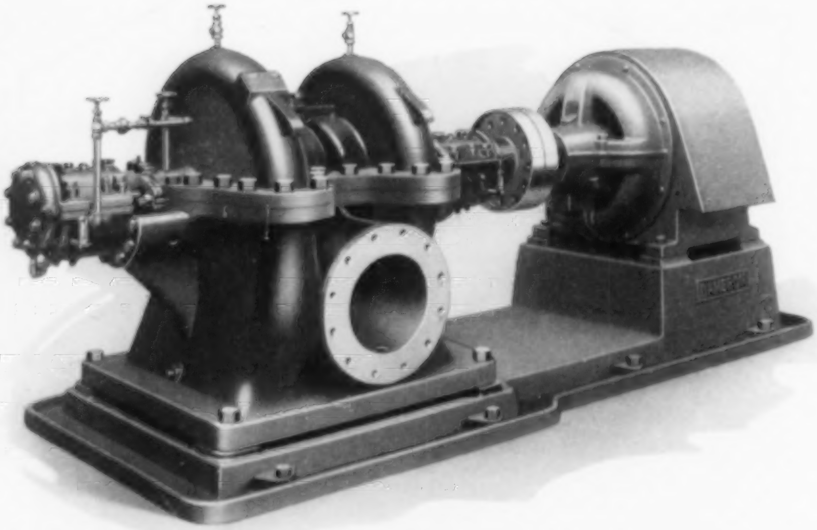
4 and 5- A heater will use no more steam than it needs to heat a required amount of water. As heat is imparted to the water because heat is wanted in the water for some useful purpose, and as overheating may be wasteful, the steam flow will be throttled as required and excess steam will most likely be disposed of elsewhere. There will be no loss in efficiency if the condensate is cooled considerably below steam temperature, for the heat taken from the condensate will be retained by the heated water and serve a useful purpose. Heater specifications would not be likely to include guarantees of condensate temperature; and steam-pressure drop through the tube bundle of a heater is a less serious design problem. Elaborate or carefully engineered tube-spacing patterns are not found in ordinary heaters.

A typical surface condenser is evaluated on different standards. It must take all the steam that is fed to it. If it serves a turbine or other prime mover, the principal function of the condenser is to enable the turbine to extract the maximum of useful energy from the steam by keeping the residual pressure (back pressure) against which the turbine exhausts always at a minimum. Any heat that is not removed from the steam and converted into mechanical energy in the turbine is lost—wasted in the circulating water when the steam is converted to water in the condenser. Consequently, it is important that the condenser shall function to provide the highest possible vacuum at all times consistent with the quantity and temperature of the circulating water, regardless of steam flow. This difficult problem involves consideration of many factors, including tube arrangement, steam velocity, pressure drop, steam distribution, etc.

The condenser must be sized to provide an average seasonal vacuum that will permit the turbine economically to meet average load demands with virtually optimum seasonal utilization of the steam at the throttle. Generally, no useful purpose is served by supplying an oversized condenser that will provide the optimum of vacuum at peak load when the circulating water is at its highest incoming temperature, because power plants seldom operate at anything like this peak condition over any appreciable period.

Inasmuch as all heat withdrawn from the steam by a condenser is wasted, it is important that the condensate shall not be subcooled. The condensate, which is invariably returned to the boilers, should, under ideal conditions, have a temperature corresponding to that of the steam entering the condenser. In other words, only the latent heat should be removed from the steam in its passage through the condenser. For this reason it is necessary to make careful provision against subcooling of the condensate.

The relatively low temperatures and the low temperature differences encountered in condenser practice indicate that condensers need more surface per unit of heat trans-



CONDENSATE PUMP

This unit, with its direct-connected motor driver, is a typical 2-stage, centrifugal hotwell pump. It is especially designed with large entrance areas to the first-stage impeller for handling condensate with a very high vacuum on the suction. High discharge heads can be obtained with pumps of this type in spite of difficult suction conditions.

ferred than do heaters. Consequently, condensers tend to be expensive heat exchangers. It is therefore important to proportion condensers so that all entering air will be continuously and forcefully swept off the tube surfaces and out of the shell to the air-removal apparatus. It is the only way to prevent air-blanketing, which puts a greater or lesser percentage of the valuable condensing surface out of commission.

Air in the shell and mixed with the steam also tends to dissolve in the condensate whenever the latter is cooled to a point below steam temperature. Oxygen-free condensate is a matter of vital importance today where the condensate is to be used as feed for high-pressure boilers. Its deaeration as it collects in the condenser is therefore just one more problem with which the designer has to cope and is a matter of considerable concern to purchasers of large units.

Comparative Size of Surface Condenser

In developing the analogy between water heaters and condensers, we have found that the size of the apparatus tends to increase as the operating pressure becomes lower. Compare Example 3 with Example 2. A condenser serving a turbo-generating unit and built on the basis of 72°F. circulating water would probably be proportioned to provide an absolute pressure of 1.6 inches Hg. (28.4 inches vacuum). To make the comparison with Example 3 as close as possible, let us assume that economy in the use of water is the paramount consideration, and design the unit for the high ratio of 0.77. Further, let us again use ¾-inch-outside-diameter No. 18 Bwg. tubes and a water velocity of 6 feet per second.

EXAMPLE 4

Steam temp. (equiv. to 1.6″ Hg.) = 93.8°F.
Cold-water temperature, inlet = 72.0°
Initial temperature difference 21.8°

with a ratio of 0.77,

$$TR = TD \times 0.77 = 21.8 \times 0.77 = 16.8^\circ$$

If the steam load to be condensed is 36,000 lb./hr., and approximately 950 Btu. per pound is to be removed in the condenser to convert the steam to water, the heat transfer load will be:

$$36{,}000 \times 950 = 34{,}200{,}000\ Btu./hr.$$

This loading is about the same as that in Example 3. The heat added to the circulating water will increase its temperature by 16.8°, or from 72° to 88.8°. Therefore, the quantity to be circulated will be

$$\frac{34{,}200{,}000}{8.33 \times 60 \times 16.8} = 4070\ gpm.$$

The condensate will be approximately 72 gpm., or 36,000 lb./hr.

For a modern high-efficiency surface condenser, the design heat-transfer coefficient will be greater than that used in the previous examples for heaters. The reason for this is that there is justification, on account of the difficult operating conditions for which condensers are built and the economy resulting from the most effective utilization of the surface supplied, for paying close attention to refinements that will bring about high heat-transfer rates. Present practice affords a design coefficient of 668 Btu. per hour per degree of mean temperature difference (Fahrenheit) per square foot of external tube surface for ¾-inch-outside-diameter tubes of No. 18 Bwg. and with a water velocity of 6 feet per second, based on 72° water inlet temperature.

The logarithmic mean temperature difference is:

$$LMTD = \frac{16.8}{log_e \frac{21.8}{5}} = \frac{16.8}{log_e 4.36} \qquad (4)$$

$$= \frac{16.8}{2.3 \times log_{10} 4.36} = \frac{16.8}{2.3 \times 0.64}$$

$$= \frac{16.8}{1.472} = 11.4^\circ$$

The required heat exchange surface is:

$$Surf. = \frac{34{,}200{,}000}{668 \times 11.4} = 4490\ sq.\ ft. \qquad (5)$$

Note that this area is three times that obtained in Example 3, in spite of the fact that the coefficient is higher owing to improvement in design. Although both load and ratio are slightly smaller, the surface required and the size and cost of the unit have been greatly increased solely because the initial *TD* has been greatly reduced. Evidently, designers have had ample incentive to include all practicable refinements in the engineering design of these vessels. Much progress has been made, and this is demonstrated by the fact that current average ratings, compared with those of 1920, involve about one-half the square footage of condenser surface per kilowatt of generator capacity.

Conclusion

To sum up, condensers have become so highly developed and so efficient that evaluation is based on many factors, which include:

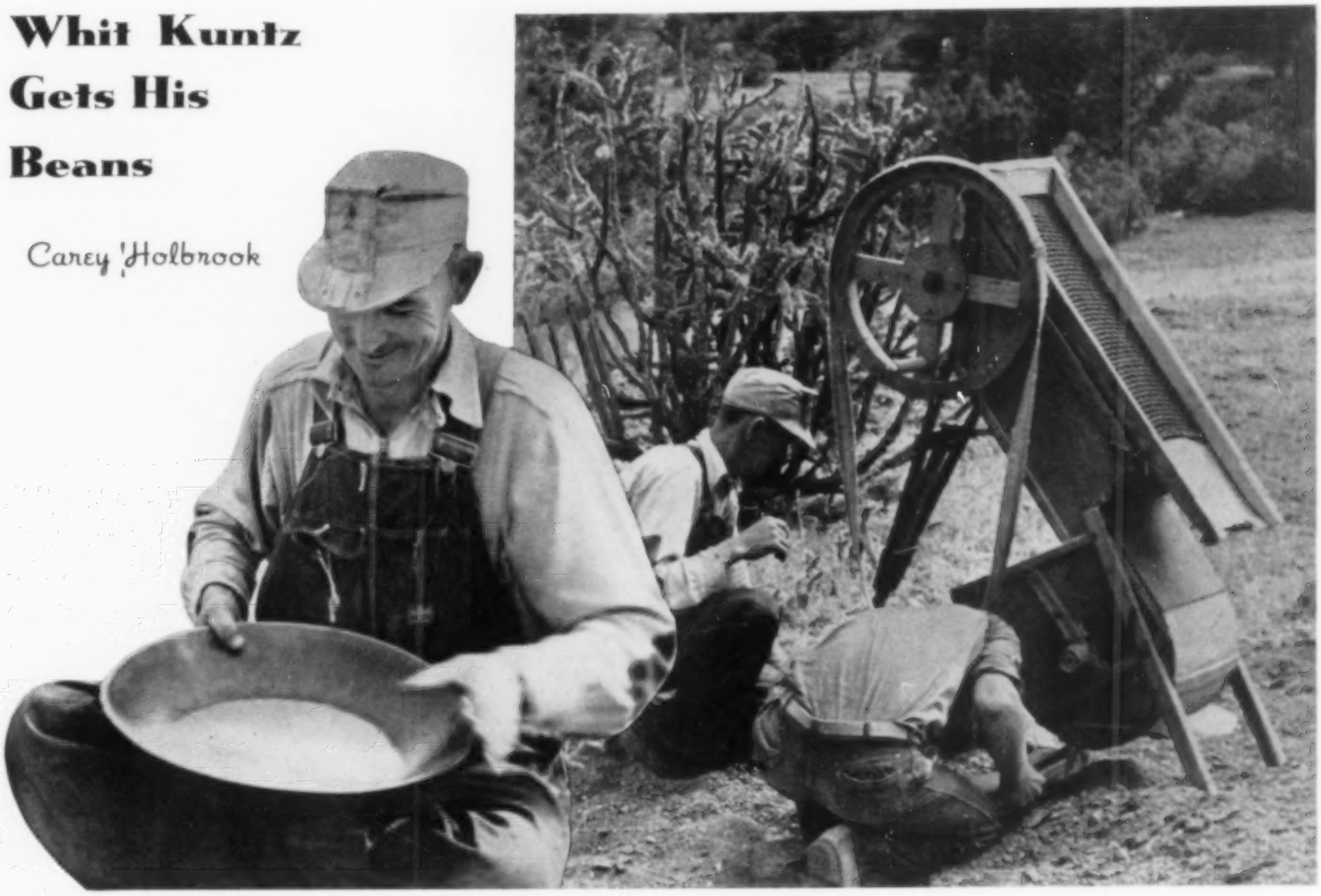
1- Steam load
2- Circulating-water temperature
3- Circulating-water quantity
4- Circulating-water friction
5- Air-removal capacity
6- Ejector steam consumption
7- Condensate temperature
8- Minimum oxygen content in condensate
9- Amount of heat-transfer surface
10- Means for controlling steam distribution
11- Tube size and material
12- Tube length
13- Number of water passes
14- Size and proportions of shell
15- Mechanical and structural details

It is entirely beyond the scope of the present article to attempt even an abridged discussion of the many interesting technical features of the modern, high-efficiency high-vacuum surface condenser. However, it is the writer's hope that he may, through his effort in this series of articles to explore the underlying principles of condenser design, arouse interest in a highly specialized engineering product that has received little popular attention.

This is the concluding article in the series.

Whit Kuntz Gets His Beans

Carey Holbrook



WHIT AND HIS DRY-PLACER MACHINE

The gravel is shoveled upon the screen. The fine material passes through, and as it falls in the chute air is blown up through it by turning the crank by hand. The blast carries the light material away while the heavier pieces, including particles of gold, collect in the hopper at the bottom. At the left, Whit smiles as he pans the residue.

Old Whit Kuntz he wiped his face,
Sat him down in an easy place,
Took his bucket between his knees
And said to himself in words like these,
"You can't starve me, or the next damn man,
When there's stuff like this for a guy to pan"!

Old Whit Kuntz hitched up his belt,
Brushed up a bucket of snow to melt,
Turned a wheel with a rusty crank
And shoved his shovel into a bank.
"Hell," he said to his battered pick,
"These loafing gents sure make me sick"!

Old Whit Kuntz was a simple soul
Gouging around in a pigeonhole,
Raising blisters on either hand
For a speck of gold in a ton of sand.
"Its tough," says Whit, "and hard to beat,
But it brings me in enough to eat."

THERE'S gold in them thar hills! For more than 100 years men have been scratching around with pick and shovel and pan; with dragline and dredge and drill—and there's still gold in the hills of the Sierra del Oro.

Back in 1828, a sheepherder named Ortiz stumbled on the first signs of gold near Dolores, N. Mex., and he was smart enough to know a streak of color when he saw one. History doesn't reveal what Senor Ortiz did with his sheep after he had found gold, but what he did about the gold strike was to spread the news until the whole section boiled with the gold fever. Into Dolores they came, hell bent for the gold fields, and they blew the metal out with air, washed it out with water saved from melting snow, and tumble-bugged it out by main force. And that's just what they are doing up there today.

Five years after his first find, Senor Ortiz struck gold again about 2 miles south of Dolores. This new area was immediately christened Sierra del Oro—the mountain of gold, and the name wasn't so far off at that. He started operations in what was possibly the first lode mine developed in America. Since Ortiz knew more about sheep than he did about mining he took in another *hombre* named Lopez as a partner, and the two of them proceeded to work that mine to a fare-you-well. Lopez got rich out of the Sierra del Oro; but Ortiz finally nudged him out of the mine and chased him back to Mexico where he came from. He then proceeded to drink himself to death, which didn't matter so much, since his mining operations were unprofitable without the skillful hand of his *compadre*, Lopez.

Eleven years after the first placer strike at Dolores, another placer find was made at Golden, a few miles southwest of the original discovery, and since that time—for more than 100 years—they have been taking gold out of that district by every method known to mortal man. They are still taking it out. And they are using equipment ranging from a teaspoon to a tipple in their mining operations.

As a gold camp, Golden is an old-timer. It is located in the bleak and black hills south of Santa Fe, east of the main highway, No. 85, and a long, long way from water. Once upon a time Golden was a roaring gold camp, with a bank, a stock exchange, a newspaper, and a couple of thousand bearded inhabitants. But that was once upon a time. Now it is little more than a hamlet haunted by memories of another day.

During the past 100 years there have been various large-scale operations in the Golden District. Thomas A. Edison was interested in it along about the turn of the century. He built a huge machine to extract the gold from the gravel; and it screened, and puffed, and separated in search of the precious stuff. But it was a failure, and Mr. Edison wound up his operations at Golden 40 years ago. Plenty of gravel has run under homemade blowers since that time.

The formations in the Golden District make mining a sort of chase after a rainbow, Poking their black heads into the sky are San Pedro Mountain, South Mountain, the Ortiz Hills, and the Cerrillos Hills. Back when the world was young, some volcanic disturbance hurled them up, and ever since then the forces of erosion have been busy trying to tear them down. But the process of erosion has been a sort of hit-and-miss affair, owing to the fact that this is a dry and desolate land where the rainfall is very irregular. But when the rain gods occasionally open up with their big guns, they do it in no half-hearted manner.

The rain falls in torrents, but over only a small area. And when it does rain the run-off comes down out of the mountains with a rush that carries with it gravel and bowlders and anything else in its path. If that path happens to be one rich in gold-bearing quartz, the deposit left at the foot of the mountain is rich in pay streaks. If the path happens to be barren of gold, a huge mass of worthless stuff is laid right on top of all that has gone before. Consequently, the chase after the glittering treasure is a hot-blooded gamble. Today you are right in the middle of a golden *manta* or blanket of gravel, the sun of prosperity shines down, and all is well with the world. Tomorrow your pay streak has petered out and you are just a poor sweating fool hunting for another rainbow. Mining at Golden is like that! Life is like that! *Muy poco pan por dos reales*! If, perchance, this were a land of regular rainfall, with water to spare, then large operations would be a comparatively simple thing. But it is not, so the Golden District continues to produce gold in devious ways.

TURNING THE CRANK

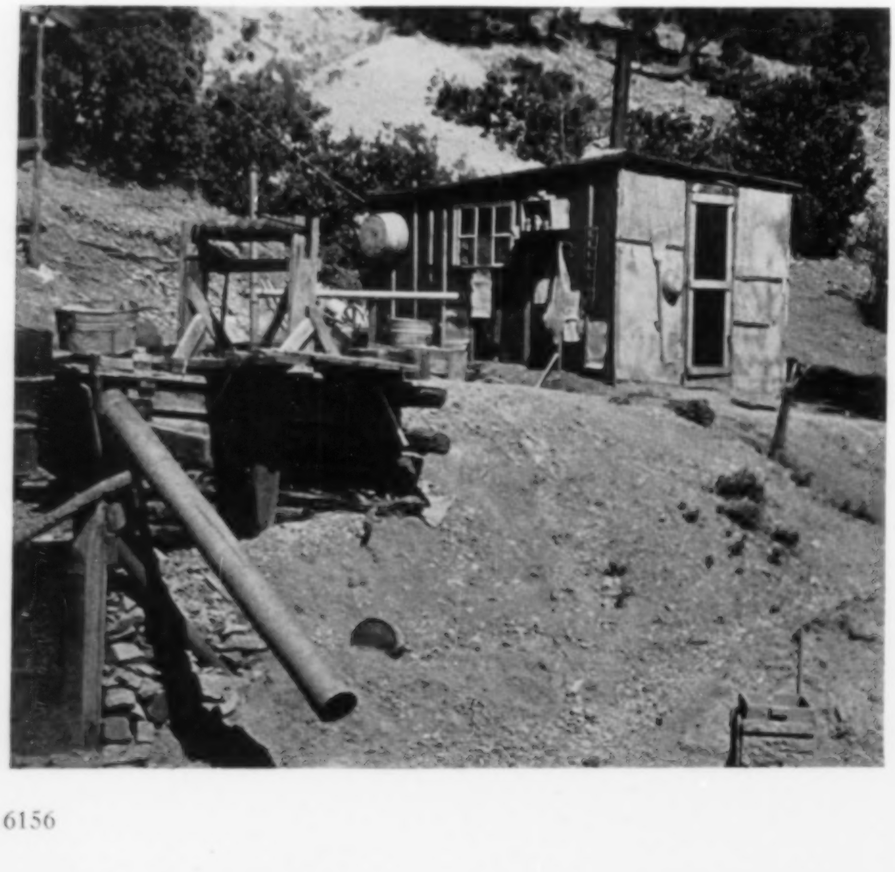
Take R. A. Kent, for instance. He has been mining there a long time. His plant is a pick-up truck into which is fitted a machine made of gasoline barrels, a blower operated by a gas engine, and various other gadgets. He has a device that dries his gravel so the blower can get in its work. He feeds the gravel in at one end, and by some mysterious process the pay dirt comes out the other. When his *manta* plays out he moves on to another spot. And his system must work, because he eats regularly.

Then there is old Whit Kuntz and his 20-year old nephew, who came to Golden from Texas. Their machine is a sort of 4-legged contraption operated by hand. Their tools are a couple of shovels and a bar. Their working hours are from can to can't, and their "take" is about $28 a week. "But you can never tell," old Whit says, "tomorrow we may turn up a chunk as big as your fist and put us both on easy street." So they continue to dig up the gravel, pitch it into their machine, turn the crank and watch for the shining specks that mean beans in the pot for them. And when a speck does show up they carefully herd it into a bottle along with the specks they have found before and, *poco tiempo*, they have a week's wages. There are plenty of other small operators in the Golden District who use similar methods. They scratch away at the gravel, pan or wash or blow, and go from *manta* to *manta* with their crude machines.

During the past year there have been a lot of mysterious activities in the Golden area, principally at the old San Pedro Mine where John J. Raskob and his associates are going after their gold in a big way. Modern machinery has been moved in. In December, 60 miners were reported to be at work. Important-looking men flit back and forth between the mines and the city of Albuquerque where R. P. Raskob, son of John J., has taken up his residence.

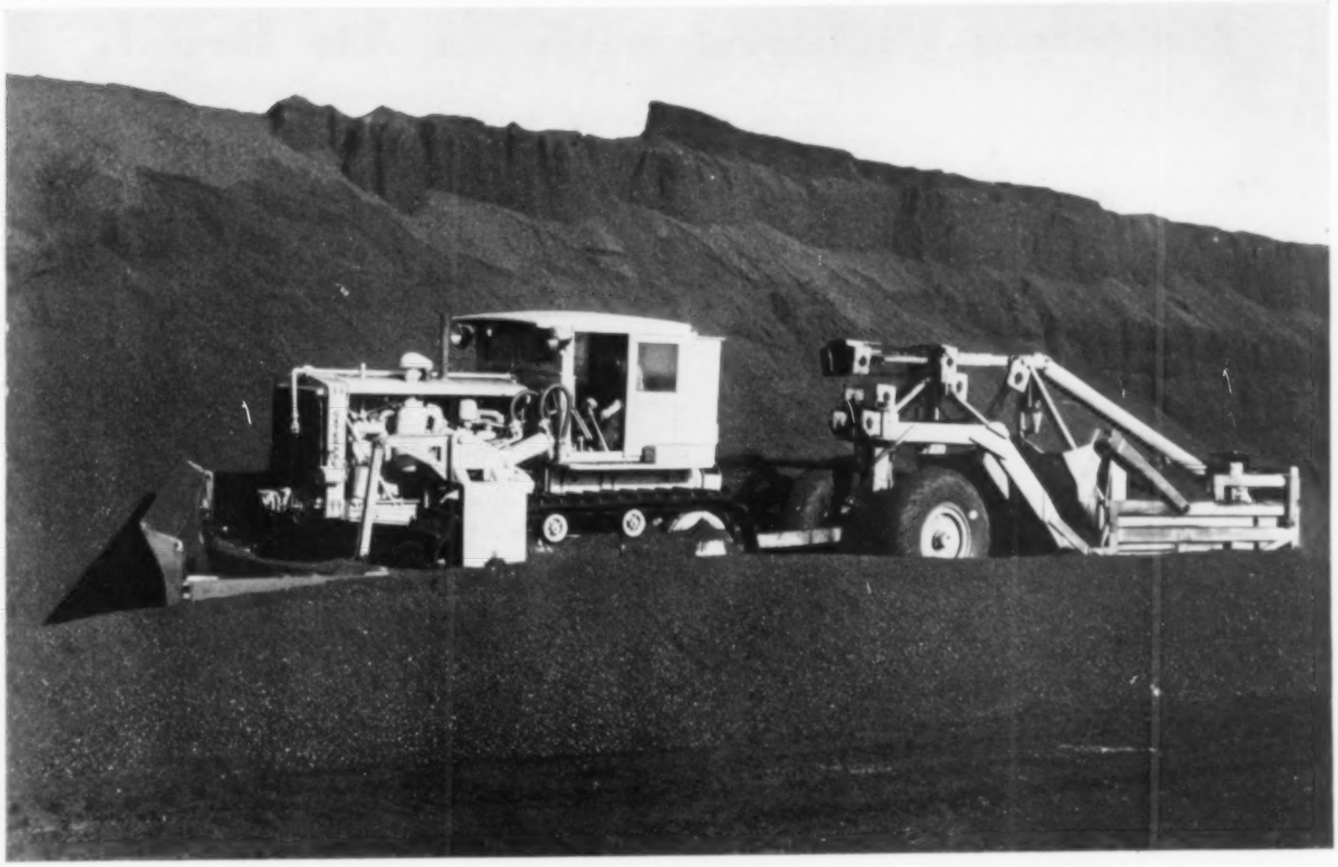
Of course the elder Raskob has his fingers in a lot more things in New Mexico. In oil, for instance, down on the Tome grant in Valencia County, where a mammoth rotary is screwing its way into the earth. And farther down the Rio Grande, where he is interested with Tom Campbell, the Montana wheat king, in a huge acreage purchased from the state.

But that is another story. An entirely different tale, and an entirely different district from the Golden gold area where old Whit and others like him continue to grind their homemade machines and pick up gold in the same place where the initial strike was made more than 100 years ago.



WHIT'S HOME AND NEPHEW

The house was made principally from shipping crates and tar paper; but in New Mexico's arid climate it offers sufficient protection against the elements. Whit's helper is his 20-year-old nephew.



COAL-HANDLING EQUIPMENT

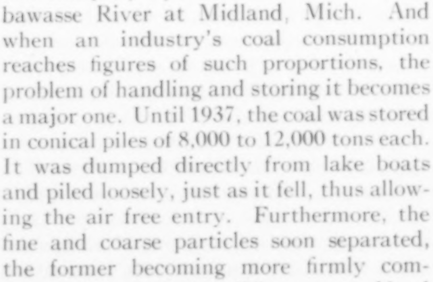
The single crawler-type tractor by means of which the large quantities of coal used at the Midland plant of The Dow Chemical Company is moved, distributed, and compacted in building up storage piles made up of horizontal instead of the usual oblique layers. The tractor is air conditioned and heated for the comfort of the operator.

No Air in Coal Pile --No Fire

A THOUSAND tons of coal a day, that is the requirement of The Dow Chemical Company's plant located on the Tittabawasse River at Midland, Mich. And when an industry's coal consumption reaches figures of such proportions, the problem of handling and storing it becomes a major one. Until 1937, the coal was stored in conical piles of 8,000 to 12,000 tons each. It was dumped directly from lake boats and piled loosely, just as it fell, thus allowing the air free entry. Furthermore, the fine and coarse particles soon separated, the former becoming more firmly compacted than the latter. When a second load was dumped on top of the first one, the same thing happened, and so on, forming a pile made up of alternate layers of fine and coarse coal. The latter, not being tightly packed, constituted what might be called flues which, in case of fire, functioned much the same as conventional flues do in chimneys. In other words, the warm air rising through them allows cold air to filter through the coal at the bottom and to feed the flames. Temperatures were taken weekly, and an average rise of one-half a degree per day was noted—the increase being the result of chemical reaction between the oxygen in the air and the constituents of the coal. It was often necessary to repile the coal to prevent spontaneous combustion; and even though this involved a considerable outlay, the expense was minor compared to that incident to fires of this sort.

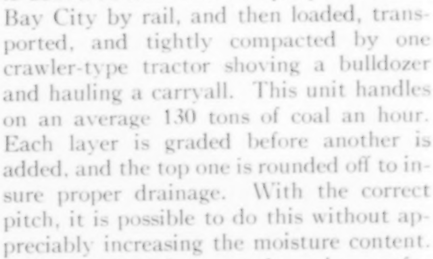
When it became necessary three years ago to carry a larger stock for a longer period of time, the whole question of handling and storage was investigated, with the result that the coal is now piled at the plant in horizontal and not in oblique layers. It is delivered from the Company's docks at Bay City by rail, and then loaded, transported, and tightly compacted by one crawler-type tractor shoving a bulldozer and hauling a carryall. This unit handles on an average 130 tons of coal an hour. Each layer is graded before another is added, and the top one is rounded off to insure proper drainage. With the correct pitch, it is possible to do this without appreciably increasing the moisture content.

The method has now been in use for three years, and in that time no temperature rise has been noticed, even after eighteen months of continuous storage, and there has been no need of any repiling. It is further claimed that it effectually eliminates the formation of flues and therefore the infiltration of fire-breeding oxygen.



OLD AND NEW WAY

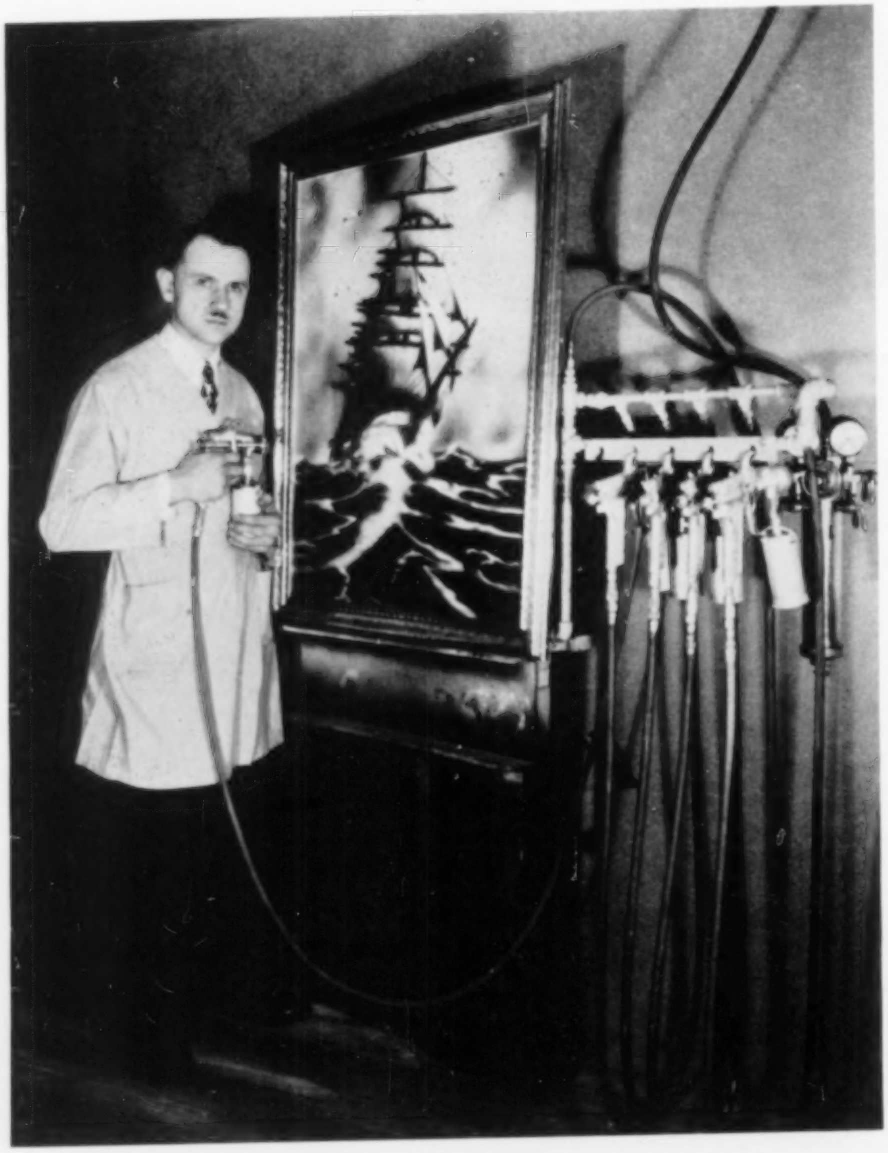
The drawing at the left is a cross section through a loosely dumped conical coal pile showing how the material is disposed in solid layers of fine material with intervening layers of coarse material, the latter constituting flues. By the present method (right) the fuel is piled in horizontal layers which are successively graded and consolidated to form a well-compacted mass that prevents the infiltration of air and thus reduces the fire hazard.



Painting Pictures with an Air Brush

IN OUR November, 1939, issue was a brief item concerning Ralph L. De Gayner, who paints pictures with spray guns. We are now able to give some additional facts concerning his work and the manner in which he does it. Having ascertained that there is a market for all the pictures he can produce, Mr. De Gayner has established a studio in the stillness of the northern Michigan woods, where he is applying himself assiduously to his unusual form of art. "When I first introduced painting with an air brush," says Mr. De Gayner, "the spray-gun company for which I gave exhibitions insisted on speed to make the demonstration snappy and hold the attention of the audience without tiring them. In my new environment, all this has changed to the quiet side, and I believe that my work is better as a result."

Mr. De Gayner spent six years mastering the technique of spray-gun painting on canvas. A former commercial artist, he picked up a spray gun one day in his father's industrial paint shop in Iron Mountain, Mich., and made a rough sketch on a wall. His interest was aroused in the possibility of employing the apparatus for artistic work, and he began to practice with it regularly. In the end he succeeded in acquiring so delicate a control of the trigger that he was able to paint fine lines and to obtain other effects that previously had been considered impossible of accomplishment with any medium other than the conventional brush. He reports, however, that his greatest difficulty was not that of conquering the triggering of the gun, but, rather, that of producing pictures of artistic value. "The fact that I am able to execute unique paintings with a spray gun does not in itself insure the success of those pictures," he states, "it is the quality of the paintings that determines whether or not my work is worth while doing. I am now concentrating on getting better composition and color effects, and proof that I am improving is found in the type of art dealers who are writing for quotations on my work and those who are regular customers."



SPRAY-GUN ARTIST

Ralph L. De Gayner standing before a finished painting of a clipper ship in his new studio near Channing, Mich. At the right is a combination compressed-air manifold and spray-gun rack. By utilizing a separate gun for each color, much time is saved in cleaning, and the work proceeds faster in consequence. Mr. De Gayner also has a studio in New York.

Mr. De Gayner believes that he is the only person making paintings of this kind without the aid of stencils. Others, he says, have tried to learn the free-hand technique, but have given up after forming the opinion that it does not permit of sharpness of detail. "All I have in front of me when I begin to paint," he states, "is a piece of canvas or academy board, standard spray guns, and several colors of standard synthetic automotive enamel. I handle the gun wide open. Sharp details are obtained by triggering, and not by reducing the pressure at the gun." Inasmuch as pulling the trigger all the way back with the gun held close to the canvas will result in a big splash when a sharp line may be wanted, the importance of skill in manipulating the gun will be apparent. As Mr. De Gayner puts it, everything depends on knowing just how far to pull the trigger, and on having the controlled touch to do it.

The studio is located in the artist's home, and an electric-driven, air-cooled compressor is set up in the basement. The air is piped to the studio, where there is a manifold with five take-offs. Mr. De Gayner uses from five to ten guns, each for a separate color. This eliminates the flushing and cleaning that would be necessary with a single gun each time a different color were applied, and it also makes for speed. The type of gun employed requires about 8 cfm. of air, and the pressure varies from 35 to 60 pounds per square inch. If an opaque effect is wanted, a heavy paint is used and air at the higher pressure is needed to break it up. Conversely, where transparent results, such as sky tints, are desired, a thinner mixture is used and air at lower pressure suffices. Mr. De Gayner prefers the standard synthetic automotive paints, unaltered in any way. They are particularly colorful, he says, because of the clear medium in which the pigments are mixed.

The best De Gayner landscapes, which are done in no more than five minutes, are being sold by art dealers for as much as $100 each. Seascapes, which take from 20 to 90 minutes to execute, are bringing from $10 to $150 each. He has painted as many as 1,500 pictures in a year.

EDITORIAL

TENNESSEE RIVER NAVIGATION

IF THE current TVA program is carried through, the Tennessee River from its mouth to Knoxville, Tenn., a distance of 650 miles, will be transformed into a series of quiet pools by 1945. According to TVA spokesmen, it will afford the most efficient waterway transportation in the world.

The completion of this chain of reservoirs will mark the culmination of a movement that was started in 1824, when John C. Calhoun, as Secretary of War, selected the Tennessee as one of the nation's three most important potential water routes and recommended construction of a canal around Muscle Shoals. That work was undertaken in 1827, but was not finished until 1890. However, a railroad was built around the shoals in 1832 to extend the usefulness of the river for transport purposes. This line is interesting in that it was the first railroad west of the Appalachian Mountains.

Despite these and other earlier efforts, however, the Tennessee has not been an important haulage artery chiefly because of its restricted channel depth and fluctuating flow. The TVA program will overcome both of these deficiencies. Meanwhile, the substitution of towboats and barges for the old-time packet boats has greatly reduced the cost of moving freight on inland waterways. This is so because a modern tow can handle ten to fifteen times as much tonnage with the same horsepower, or less.

Water transportation is, of course, slower than shipment overland, and, accordingly, the Tennessee will find its principal use in moving nonperishable goods that do not call for quick delivery. One of the chief commodities transported since the existing TVA dams improved navigation has been gasoline, of which as much as 100,000 tons has been carried to distributing centers in a year. The Tennessee Valley yields surpluses of forest products, coal, coke, limestone, marble, phosphate rock, tobacco, cotton, hay, zinc ore, and of some manufactured goods. It imports grain and grain products, iron and steel, petroleum products, sugar, salt, sulphur, agricultural implements, and most of the manufactured goods it consumes. It is likely that most of the river-borne freight will consist of items in these lists.

◆

NATION'S "OLDEST" CONCERN

THE title of the article *The Country's Oldest Industrial Concern* in our January issue turns out to be inaccurate. At the time it was written we thought that the firm in question, the Taylor-Wharton Iron & Steel Company, antedated any other concern in the United States. Taylor-Wharton officials were of the same opinion. In fact, a Government publication, that reviewed the production of ordnance in the Philadelphia area during the World War, had definitely conceded Taylor-Wharton that honor. Nevertheless, knowing from experience that it is always dangerous to call anything the oldest, largest, highest, or any other "est," we duly qualified our statement in the text. Chiefly for the sake of brevity, the heading was worded as it appears above.

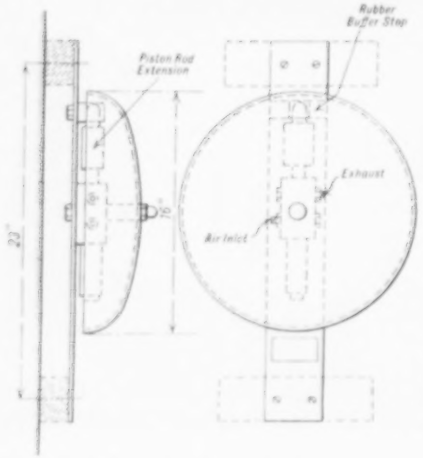
Soon after the article appeared we received letters telling us of two older firms. We passed the information along to Taylor-Wharton officials, whereupon they, suspecting that if there were two there might be more, undertook to find out just where their company stands chronologically in the national, industrial line-up. They discovered three additional concerns that are older than theirs, and another that shares age honors with theirs. There may be still others, for the Taylor-Wharton data deals only with firms that are at present operated by direct descendants of their founders. These are recorded in a book, *Centenary Firms and Corporations of the United States*, which is now in its third edition. It is the outgrowth of steps taken 51 years ago by Burnet Landreth, of D. Landreth & Sons, Philadelphia, to form an organization of firms that had been in business 100 years and that were still conducted by the families that established them. As a result of those efforts, the Association of Centenary Firms and Corporations of the United States was founded on June 12, 1889. A book was produced, under the title just mentioned, to record the histories of member concerns. Twice since that time it has been revised and brought up to date. It is of interest to note that the latest (1924) edition lists 87 firms that qualify for membership.

So far as our present knowledge goes, it appears that the oldest business concern in the United States is the Perot Malting Company, with headquarters in Philadelphia, Pa., and a malthouse in Buffalo, N. Y. It was founded in Philadelphia in 1687 by Anthony Morris, 2d. Its president is T. Morris Perot, representing the eighth generation of the Morris family. His two sons, Henry F. Perot and T. Morris Perot 3d, members of the ninth generation, are both identified with the business.

The second-oldest firm is believed to be Dill & Collins, Inc., Philadelphia paper makers. It traces its descent to the first paper mill in America that was built in what is now Fairmount Park, Philadelphia, by William Rittenhouse in 1690. Direction of the business is not, however, in the hands of descendants of Rittenhouse, for since 1932, Dill & Collins has been controlled by the Mead Corporation.

Other firms older than Taylor-Wharton are J. E. Rhoads & Sons, Philadelphia leather tanners, founded in 1702; James M. Willcox Paper Company, Philadelphia, founded in 1718; and Christopher Sower Company, Philadelphia publishers, founded in 1738. The Lea Milling Company, flour millers of Wilmington, Del., was founded in 1742, the same year in which Taylor-Wharton had its inception. So far as can be ascertained, the latter can truthfully claim to be the nation's oldest iron-and-steel producer. The next oldest firm in that line listed in the book previously referred to is Abeel Brothers, New York iron merchants, founded in 1765.

Air-Operated Warning Signal



IN THE line of sound-signaling devices, a British firm has developed a bell that is struck by an air-operated hammer. As the accompanying line drawing from *The Engineer* shows, it is a compact unit in which the gong serves to protect the striking mechanism. This is mounted on a wall panel and consists essentially of a pneumatic cylinder the piston rod of which is provided with a hollow extension carrying a spring-loaded spindle to the outer end of which the stainless-steel hammer is attached.

Air at a maximum pressure of 100 pounds per square inch is used to sound the alarm. On the striking stroke, the piston, with its extension, is forced forward until the latter comes in contact with a rubber buffer through which the hammer head passes and continues to advance under its own impulse to ring the bell. The blows are delivered at the rate of several hundred a minute; and as the hammer at the instant of impact still has sufficient inertia to travel 1/8 inch, a clear and resonant tone is produced. The bell is made by Monitor Patent Safety Devices, Ltd.

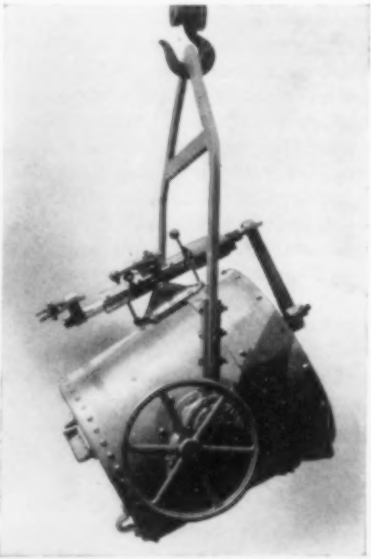
Hoist Gets Radio Orders

BY SIMPLY changing from bells to the human voice in maintaining communication between the hoisting engineer and the cage, the time interval between giving and carrying out orders has been shortened to such an extent, according to the general manager of the Homestake Mining Company, that the service has been materially improved. Signaling is effected by a close-coupled radio, and the system consists essentially of a microphone on the cage and of two coils, one clamped around the hoisting cable just above the cage and wired to the microphone and the other right under the head shield and wired to the radio equipment.

When first installed, a bell served to communicate the code messages to the hoisting engineer: now the cageman simply gives the signal orally, and the response is instantaneous. For example, it is very much faster and surer to have the "cager" say *74* than to ring seven bells, stop, and ring four more. The system, says the general manager, "can be made 2-way, but so far we are using it only 1-way. It has been in successful operation for a number of months, and all the hoisting engineers and cagers have been unanimous in their preference for it from the time it was placed in service." Furthermore, constant communication increases the factor of safety.

Ladle with Self-Locking Tilting Device

FOR the more efficient handling of molten steel and other metals, Treadwell Construction Company has recently introduced a line of worm-geared ladles ranging in capacity from 2 to 5 tons. The principal structural features of this new equipment are a stopper rig or harness and a self-locking tilting device. The stopper rig is made up of a carrier arm, a slide, a guide, and a rod that extends down through the ladle and is provided with a plug made of graphite. The rod is protected by a sleeve of fire clay or heat-resistant terra cotta. When the plug is raised, the molten metal is drawn off through the bottom where the slag, which floats on top of the molten mass, is prevented from flowing into the ingot mold or casting.

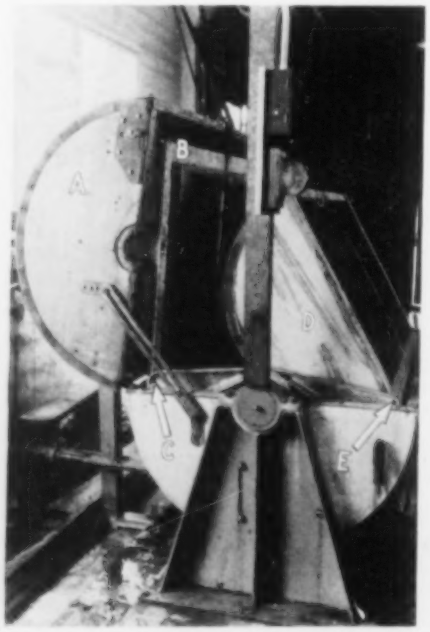


The tilting device is mounted integrally with the bail on the ladle trunnion. It consists of a worm wheel which, in turn, engages gear that is pitched sufficiently low so that the movement of the ladle is always under control. The entire mechanism is operated by a hand wheel. Our illustration shows a 4-ton ladle suitable for handling molten steel. It is made of 3/8-inch steel plate, and is 4 feet high and 4 feet in diameter. Similar units but with less gear clearance are available for tin, babbitt, lead, zinc, etc.

Pneumatic Rams Empty Clothes Washer

JEAN BOULADE, owner of a laundry in Alturas, Calif., has developed a washing machine that automatically dumps its charge of clothes through the action of two rams that are operated with compressed air. The cylindrical washing compartment is split longitudinally, and each half is hinged so that it can be elevated. The upper half is first raised out of the way, after which the lower half is lifted and partly rotated so as to dump the clothes into a waiting truck.

The necessary operations take only a few seconds, whereas the conventional method of opening a washer and removing the clothes by hand is said to require as long as twenty minutes in the case of a 4-compartment unit. The saving in time considerably increases the output of each machine. The inventor was moved to work out an automatic system because of illness suffered by him as a result of taking the hot, wet clothes out of washers. In addition to the periodical wetting from splashing water in the course of that operation, the machine attendants are compelled to inhale steam. Besides the benefits mentioned, it is said that the automatically dumped washer precludes all possibility of damaging clothes during their removal.



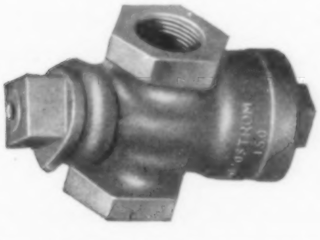
END VIEW

An air-operated ram raises the outer cover, *A*, into the upright position shown. The same ram then lifts the upper half, *B*, of the inner cylinder. This is hinged at *C* and fits in *A*. A second ram next raises the lower half, *D*, of the inside cylinder which is hinged at *E* so that its top tilts to the right and dumps the contained clothes into a waiting truck.

Industrial Notes

A self-lubricated cock for use with compressed-air lines and a lubricated plug cock for gauge lines are among the new products of the Merco Nordstrom Valve Company. The air cock is intended for service on air lines under a working pressure of 150 pounds per square inch or less and is operated by a wrench. The body of the valve is of high-grade semi-steel, and the square fitting of malleable iron which receives the wrench is rigidly attached to the exposed end of a tapered brass plug in the larger end of which is a sizable reservoir for the lubricant. This is forced by means of a simple piston-and-spring assembly through a set of lubricating grooves to the contact surfaces of the plug and body, thus automatically and continually oiling the valve throughout the entire operating-pressure range from zero to the maximum for which it is intended.

FOR GAUGE LINES



FOR COMPRESSED-AIR LINES

The lubricated gauge cock was developed to provide a leakproof cock for water, oil, and gas lines. It is designed for a rated working pressure of 2,000 pounds and for test pressures up to 4,000 pounds per square inch. It is wrench-operated, and can be completely opened or closed with a quarter turn. Stick lubricant is used and inserted under a screw which, when turned down, causes hydraulic pressure to be exerted against the valve seat. Special lubricants are available for steam. This cock has a forged-steel body and a stainless-steel plug. It is made in ¼- and ⅜-inch sizes.

In the Middle Western states, according to The Dow Chemical Company, pneumatic tractor tires are being ballasted with an antifreeze solution of calcium chloride. The weight thus added amounts to as much as 25 per cent—more than with ordinary water—and is said to lower the center of gravity, reduce bounce, and increase the drawbar pull of tractors, all of which tend to lengthen their service life. A tire of average size—they are made as large as 9 feet in diameter—can be filled in fifteen minutes by means of a service-station gasoline pump, which transfers the solution under an electric or compressed-air impulse from a drum to the tire through two hose lengths, one extending from the pump intake into the drum and the other from the pump exhaust to the tire. The building up of excessive pressure in the tire is prevented by the use of a suitable fitting.

The B. F. Goodrich Company has provided a coating for rubber or rubber-impregnated conveyor belts that is said to protect them both when in use and in storage against the deteriorating action of sunlight and air.

By means of a trigger arrangement, with which a new electrically heated soldering iron is equipped, the operator can hold the work in one hand, the tool in the other, and deliver a drop of solder at a time, as needed. The tool is 12 inches long, operates on 115-volt alternating or direct current, and is known as Pushbutton Iron.

Under the name of Screw-Tite, the Independent Nail & Packing Company is making a nail with a long-pitch spiral thread for laying flooring. The thread causes the nail to turn as it is being driven and acts as an anchorage that prevents it from working loose. It is available in standard sizes; but the company is prepared to furnish special sizes in quantity.

Among the newest aids for the automobile service station is a fluoroscopic device that has been developed by the General Electric X-Ray Corporation. It enables operators to detect breaks, bruises, cord separations, and foreign objects such as nails, wire, glass, stones, etc., in the casings of tires up to 8-ply without taking them off the wheels. It is called the Tire-O-Scope.

Curbs that can be raised or lowered at will by the push of a button are being considered by the City of Chicago for its proposed $205,000,000 superhighway system. Such curbing, it is claimed, would give a 100-foot-wide road the same traffic capacity as one of the conventional type 160 feet wide. The idea is to divide the 100-foot pavement into ten separate lanes which could be used according to traffic needs. For example, during the morning and evening rush hours as many as eight lanes could be made available for the steady stream of vehicles moving in one direction, with the highway equally divided in between times when traffic is normal. When necessary, all the curbing could be lowered flush with the pavement to provide an unobstructed thoroughfare. It is argued that the system would cut down the amount of land and the number of buildings that would have to be condemned for the speedways, thus reducing the cost of the project by as much as $25,000,000.

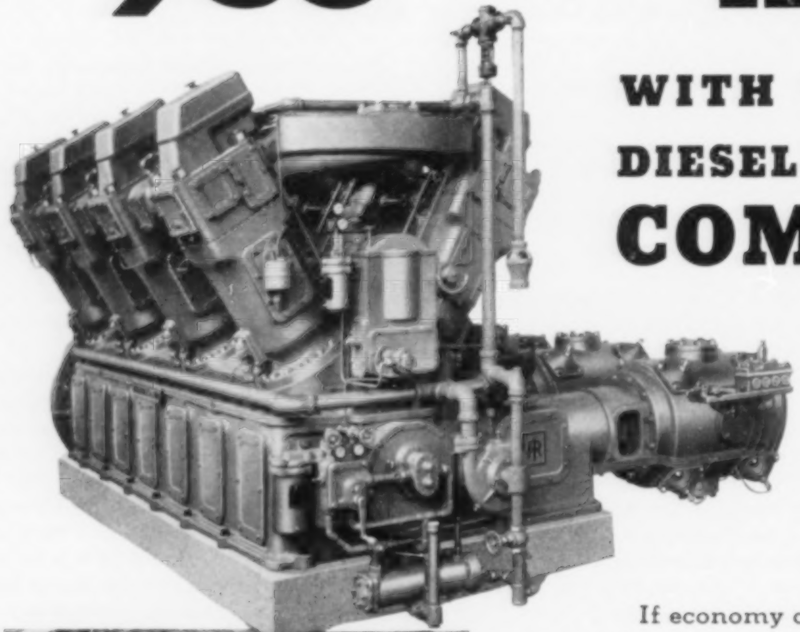
For insulating boilers, bulkheads, economizers, fittings, headers, pipes, pumps, etc., and for fireproofing structural steel, the Eagle-Picher Lead Company has put on the market a powder known as Eagle Q-S. It is mixed with water and sets in about an hour in dry air and withstands heat in from three to five days after application. The material is packed in bags containing 50 pounds, which is sufficient to give a surface 38 feet square a wet coat 1 inch thick.

According to a United States consular report, Germany is substituting bentonite for wheat flour as a stiffening and swelling agent in dry cells. It is said that bentonite suspended in water and mixed with an electrolyte produces a thick, stable paste with a pH value of about six. Such dry cells have the same electrical tension and durability as those made with wheat flour, and the zinc is not affected nor corroded by the electrolyte.

As a protection against sparks and flying particles, The Boyer-Campbell Company, makers of safety equipment, has designed a combination light and shield for the use especially of grinder operators. The shield is mounted on an adjustable bracket carrying a slightly rounded frame in which lamps of the bayonet type are set. The latter focus the light right on the work; and all electrical parts are housed in an insulated chamber to eliminate the hazard of short circuits. The standard Marvel Grinder Shield has a nonshatterable glass window; but for close work and inspection purposes it can be obtained with a magnifying lens of any focal length and protected against pitting by a glass cover plate.

933 CU. FT. OF AIR FOR 1¢*

WITH THE XVO DIESEL-ENGINE-DRIVEN COMPRESSOR

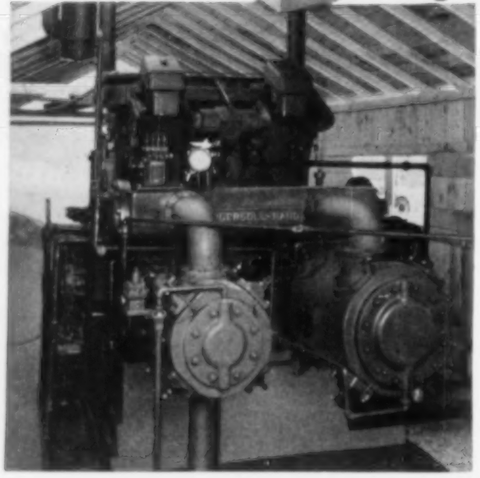


* 1¢ worth of fuel oil (6¢ per gallon) compresses 933 cu. ft. of air to 100 lbs. pressure in the XVO.

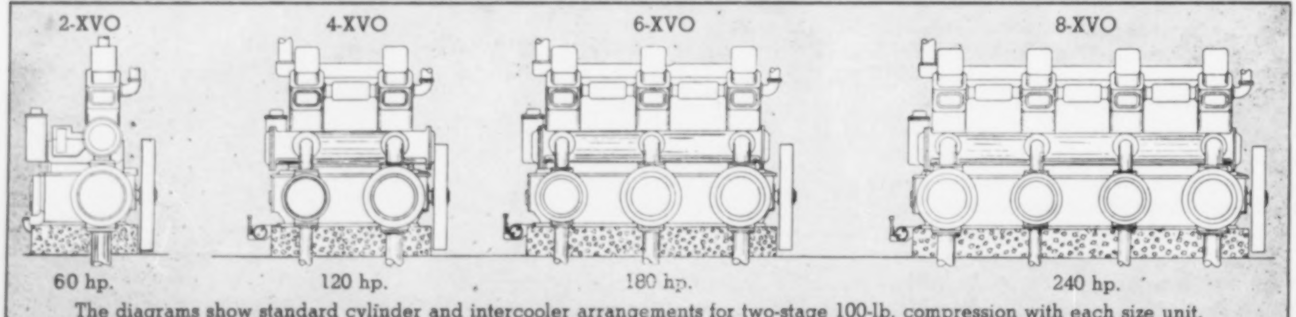
If economy counts first in your compressor plant, *do not fail to consider the XVO.* It has a higher operating economy and a much lower upkeep cost than any other Diesel-engine-driven compressor ever produced by Ingersoll-Rand. Moreover, the XVO is built for twenty-four-hour, continuous service.

If your compressor requirements fall within the power range of the XVO, there is a combination of cylinders to give you a compact, efficient unit for any pressure or vacuum. Standard units for 100 lb. pressure are available in capacities of 312, 625, 935, 1250 cubic feet per minute actually delivered.

Call or write the nearest Ingersoll-Rand branch for more information on the savings that a Type XVO compressor can make for you.



Two-stage 4-XVO furnishing air for tunnel work on the Pennsylvania Turnpike.



The diagrams show standard cylinder and intercooler arrangements for two-stage 100-lb. compression with each size unit.

Ingersoll-Rand

11 BROADWAY, NEW YORK CITY

Atlanta
Birmingham
Boston
Buffalo
Butte
Chicago
Cincinnati
Cleveland
Dallas
Denver
Detroit
Duluth
El Paso
Hartford
Houston
Kansas City
Knoxville
Los Angeles
Newark
New Orleans
New York
Philadelphia
Picher
Pittsburgh
Pottsville
Salt Lake City
San Francisco
Scranton
Seattle
St. Louis
St. Paul
Tulsa
Washington

The machine that can let out its belt when it eats too much

A typical example of Goodrich development in rubber

THRESHING day on the farm used to be a time of back-breaking work, lung-filling dust, mountainous meals for the farmer's wife to cook. Engineers developed a machine that would do away with all this—it would thresh grain automatically as it was cut.

But there was a snag in it—literally. Moving through the fields, this combine, as it is called, ate up the grain but it also gulped down rocks, sticks, heavy wads of grain and weeds. Trying to force these past the threshing cylinder, the chain drive would break.

Belts of all kinds were tried but they broke, too, or were stretched beyond usefulness. Then Goodrich belt engineers went to work. All cords in belts had always been straight. Goodrich developed a way to twist the cords in groups like a spiral spring. Then, when strain was put on the belt, the cords unwound enough to take up the shock, but when strain was removed, the cord "spring" snapped back into place and the belt was as good as ever.

With these belts to absorb the shock of obstructions and instantly spring back to operating tension, the new work-saving combine becomes a practical farm tool.

Another proof of the fact that nothing is standard or static to Goodrich engineers. Next time anyone tells you all belts (or hose or any items of rubber) are alike, find out what Goodrich has been doing lately to improve that "standard" product. The B. F. Goodrich Company, Mechanical Rubber Goods Division, Akron, Ohio.

Goodrich

ALL *products problems* **IN RUBBER**

For Pressure...for Power...
for Production and for Profit
of Saving and Service . . .
USE ONE OF THE FOLLOWING

CONDOR HOSE FOR

Air	Suction
Steam	Welding
Water	Sand Blast

75 other kinds for 81 types of service

CONDOR V-BELTS
tough, long-wearing, uniformly flexible with the minimum of inelastic stretch.

CONDOR COMPENSATED BELTS
outer, intermediate and inner plies compensated for equalized stresses—transmit power at low tension. High overload capacity. 12 advantages.

CONDOR WHIPCORD ENDLESS BELTS
flexible, all-weather flat belts of stretchless cord construction.

CONDOR BRAKE LININGS
in rolls for blocks for industrial brakes. Clutch facings.

MANHATTAN CONVEYOR BELTS
for wet or dry, cold or hot materials. Wherever tonnage costs must be kept down.

MANHATTAN ABRASIVE WHEELS
for regrinding jackbits and cutting off drill rod—fast, cool and efficient in operation.

Write for detailed information bulletins.

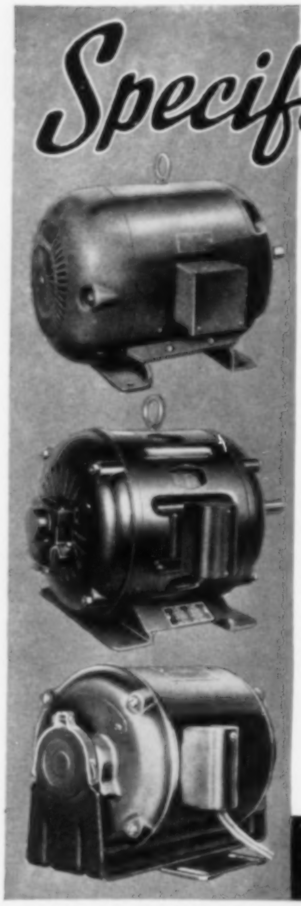
Condor
PRODUCTS

Conveyor and Elevator Belt
Transmission Belt
V-Belt
Hose (all kinds)
Chute Lining
Launder Lining
Industrial Brake Blocks and Lining
Molded Rubber Goods
Rubber Lined Tanks
Rubber Covered Rolls

Abrasive Wheels
Bowling Balls

THE MANHATTAN RUBBER MFG. DIVISION
of Raybestos-Manhattan, Inc.
Executive Offices and Factories, 22 Townsend St., Passaic, N.J.

Specify WAGNER MOTORS



ON YOUR PUMPS and COMPRESSORS

Regardless of the size, type or model of pump or compressor, the driving motor is a vital factor. No matter how good the pump or compressor may be, a failure of the motor means a shut-down. Wagner motors are dependable and their ability to stand up under severe operating conditions is your assurance of continuous service.

WAGNER MOTORS

Are available in a wide range of types and sizes—

The various types of pumps and compressors require different types of motors. Regardless of the type of service there is a Wagner motor correctly engineered to do each job.

SEND FOR BULLETINS

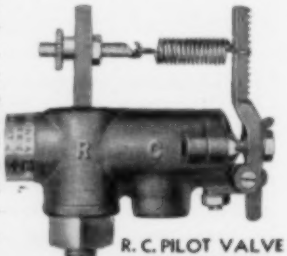
Free Bulletins MU-177 and 182 give you complete information. They are FREE—Write for your copies today.

M40-21

Wagner Electric Corporation
6400 Plymouth Avenue, Saint Louis, Mo. U.S.A.
MOTORS • TRANSFORMERS • FANS • BRAKES

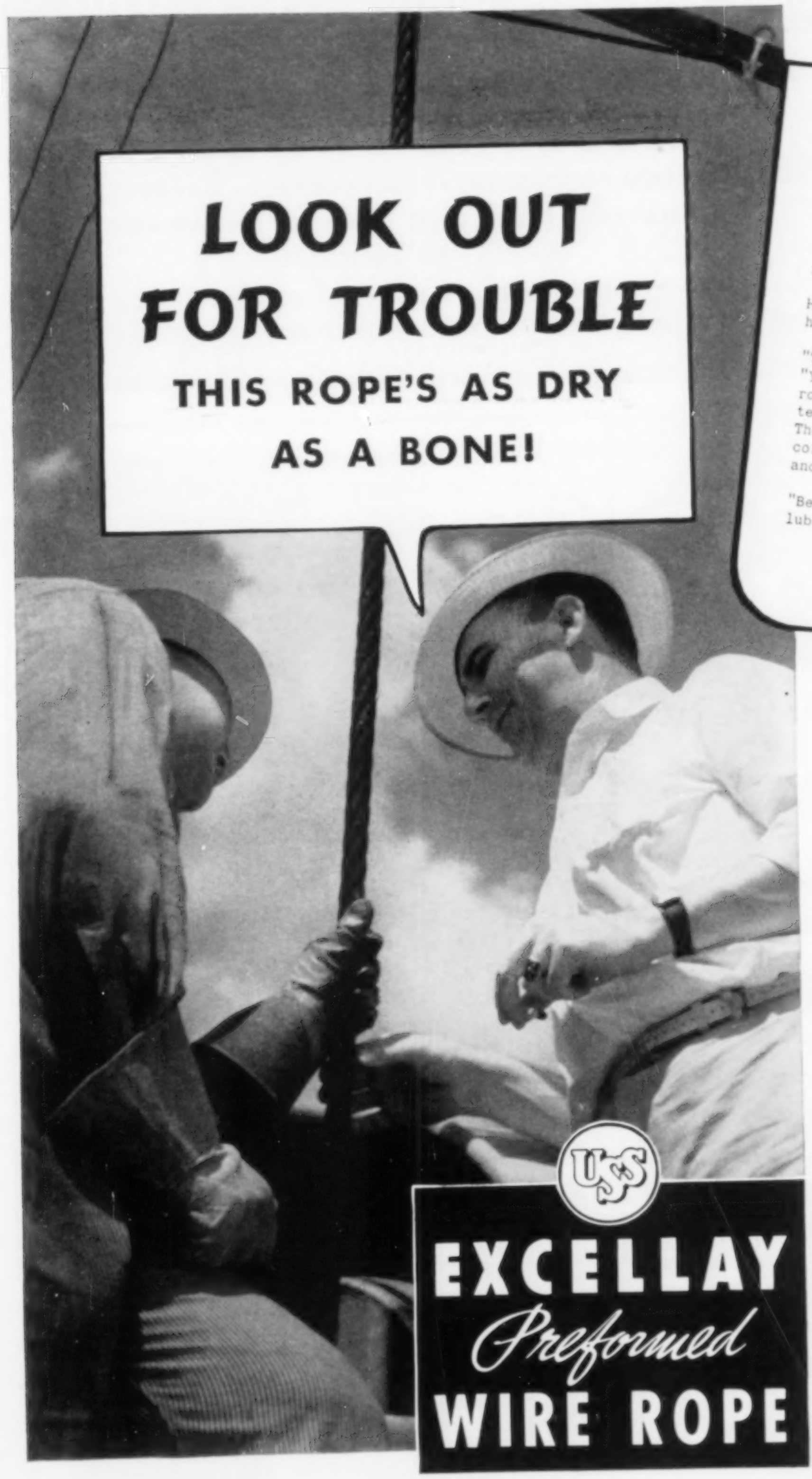
R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.



R. C. PILOT VALVE STRAINER TYPE

R. CONRADER CO.
1207 FRENCH STREET - ERIE, PA.
PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders


LOOK OUT FOR TROUBLE
THIS ROPE'S AS DRY AS A BONE!

FROM THE DAILY REPORT OF A TIGER BRAND WIRE ROPE ENGINEER

Was out on a job with Mr. Long this A.M. when I came across a wire rope that was badly in need of lubrication. "Look out for trouble here," I told him, "this rope's as dry as a bone."

He looked it over. "Looks okay to me," he said, "not much wear."

"That's just the point," I told him. "You can't see what goes on inside a rope When it's not lubricated, the external appearance may deceive you. The inside wires may be badly worn and corroded and even broken from abrasion and binding."

"Better give that rope a good dose of lubricant if you want to save it."

Yours,
Al

BY keeping your wire ropes properly lubricated, you save money two ways: You protect the rope from premature failure; and you reduce friction.

Proper lubrication is an effective deterrent to corrosion. It protects both inside and outside wires against destructive rusting. It keeps all wires free to slide over each other, as they must do when the rope bends over sheaves and drums. It minimizes friction and wear between individual wires, and between the rope and sheaves or guides through which it passes. It is the safest, surest method of preventing excessive wear inside the rope, where you can't see it.

See that all wire ropes are properly lubricated at regular intervals. Insure greater safety—prolong rope life—reduce lost time—get the benefits of fewer replacements. For specific recommendations on wire rope lubricants and lubrication practice, see the Tiger Brand Wire Rope Engineer who contacts you.

USS

EXCELLAY
Preformed
WIRE ROPE

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York
COLUMBIA STEEL COMPANY
San Francisco
United States Steel Export Company, New York

AMERICAN STEEL & WIRE COMPANY
AMERICAN TIGER BRAND WIRE ROPE

UNITED STATES STEEL

Free!
D Automatic CONTROLS
for WATER PUMPS
AIR COMPRESSORS
and OTHER PUMPING EQUIPMENT
PRESSURE SWITCHES
VACUUM CONTROLLERS
FLOAT SWITCHES
MAGNETIC UNLOADERS
LIQUID LEVEL CONTROLS
AND RELATED DEVICES
AND ACCESSORIES
SQUARE D COMPANY

SEND FOR THIS SQUARE D CATALOG

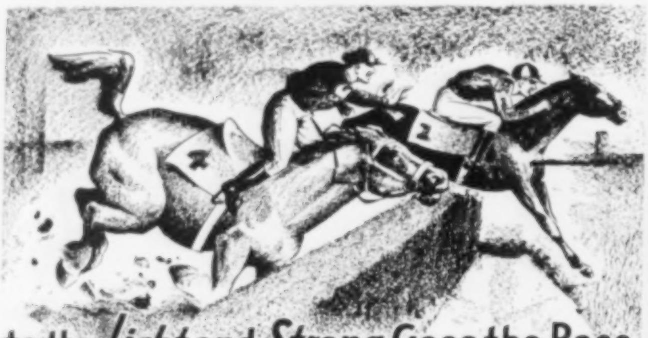
A CONVENIENT CONDENSED GUIDE TO THE LATEST IN

PRESSURE SWITCHES

VACUUM CONTROLLERS • FLOAT SWITCHES • MAGNETIC UNLOADERS • LIQUID LEVEL CONTROLS AND RELATED DEVICES AND ACCESSORIES

SWITCH—PROTECT—REGULATE . . . DO IT ALL WITH SQUARE D

SQUARE D COMPANY • REGULATOR DIVISION • DETROIT



to the *Light* and *Strong* Goes the Race

PERFORMANCE in industrial machinery never counted for more than it does today. It's a buyer's market, with every manufacturer's eye peeled for ways to better his product and keep his costs down.

Atlas Drop Forgings give you everything in super strength with light weight, save you money in final machining. Ask for our Free Engineering Assistance while planning your new or revised product.

There are Atlas Customers in Every Industry

THREE PLANTS IN ONE

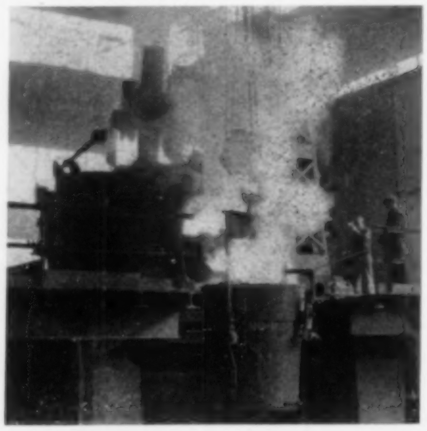
UPHOLDING QUALITY 1906 ATLAS

ATLAS DROP FORGINGS

All shapes and sizes to 500 lbs.

ANY ALLOY STEEL - LABORATORY CONTROLLED

ATLAS DROP FORGE CO., LANSING, MICH.



Control
—right
from the
start for—

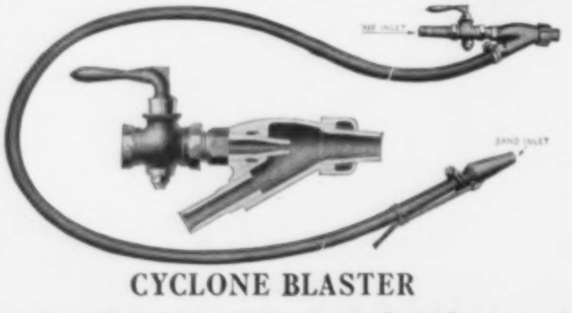
NF

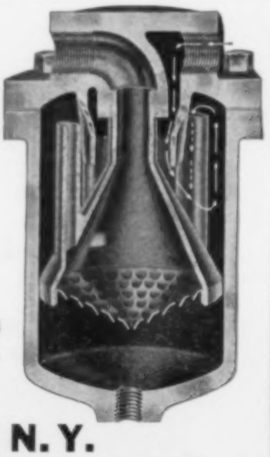
BASIC ELECTRIC STEEL FORGINGS

COMPLETE control of all processing from selection of the melting charge to the finished condition is the N. F. & O. *guarantee of quality* in forgings furnished to your specifications—Smooth Forged, Hollow Bored, Rough or Finished Machined.

NATIONAL FORGE & ORDNANCE CO.

IRVINE, WARREN COUNTY, PENNA. U. S. A.


AIR INLET
SAND INLET



DIVIDE AIR SEPARATOR

Efficiently removes *Oil* and *Water* from Compressed Air. Horizontal or Vertical Style. Results guaranteed.

These devices are the simplest and best available.
Catalogs on request.

CYCLONE BLASTER

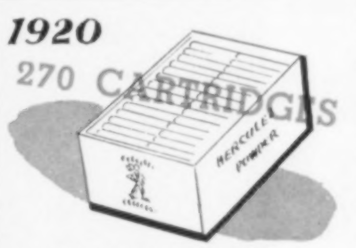
For cleaning castings, steel work, etc. with sand or steel abrasive. Saves a large initial cost. Air consumption is not increased as nozzle wears. Work can be stopped at the nozzle.

DIRECT SEPARATOR DIVISION

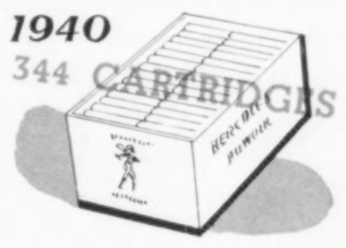
Straight Line Foundry & Machine Corp.--Syracuse, N. Y.

SOLVING *The Mystery* of the EXTRA 74 CARTRIDGES!

AN EXAMPLE OF EXPLOSIVES PROGRESS



1. IN 1920, 100 lbs. of permissibles averaged 270 cartridges. Coal mining operators demanding better prepared sizes needed higher-count permissibles.



2. TODAY, there are 344 cartridges in 100 lbs. of average permissible—each cartridge doing its job with added efficiency and economy.

3. LET'S PICK UP the trail of the *extra* 74 cartridges and find out where they came from.

4. OUR FIRST logical stop is the Hercules research laboratory. Here, we get our first look at pioneering in higher-count permissibles.

5. NEXT, LET'S VISIT the mines. Here, each new Hercules high-count permissible, tested under actual field conditions, proved helpful in producing prepared sizes.

6. LET'S INTERVIEW the preparation engineer. He says: "Better lump, more production, cleaner coal, added safety with these new modern permissibles."

7. NOW TO THE MINE bookkeeper. He says: "Modern Hercules permissibles give more lump to ship and powder cost is less."

8. THE MYSTERY is solved. The *extra* 74 cartridges result from Hercules' fixed policy of producing better and more economical explosives.

REMEMBER.... THESE FIGURES ARE AVERAGES.
Hercules Permissibles cover the full range from 200 to 500 cartridges per 100 lbs.

B-33

HERCULES POWDER COMPANY
Incorporated
WILMINGTON, DELAWARE

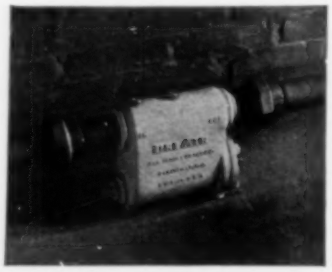
IN
OUT
DRI AIR
NEW JERSEY METER CO
PLAINFIELD N J
MADE IN U.S.A.

"DriAir" gives Dry Air

DriAir hangs from the piping above or stands on the floor below. Being a separator and trap combined into a single unit, it requires no attachments, pipes straight through and when once installed requires no further attention.

The DriAir Separator separates and automatically ejects the condensed water from compressed air lines; collects rust, pipe scale, sediment and dirt from the pipes; delivers clean, dry air to tools and other pneumatic equipment. This promotes better and more uniform lubrication and prevents rapid wear, freezing and rusting of tools. The increase in production and the saving in tool depreciation quickly pay for the cost of installing the DriAir.

Do you want Bulletin DA and prices?



NEW JERSEY METER CO.

PLAINFIELD, NEW JERSEY

Air Meters DriAir Separators Air Jet Blowers

Shush THAT NOISE

FROM STEAM EXHAUST. . . . *with*

MAXIM SILENCERS

Noise nuisance often presents a difficult problem of public relations—a problem which can easily be solved by Maxim SILENCERS.

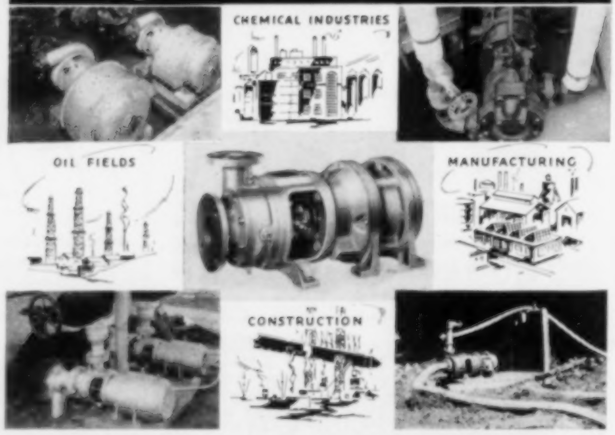
Take the installation above where a MAXIM No. 28 MU1 Silencer, installed on a Skinner Uniflow Steam engine, has effectively eliminated steam exhaust noise for the Glen Alden Coal Co. of Scranton, Pa.

If you have a similar problem, or one involving the silencing of high pressure waste steam discharges, internal combustion engine exhausts or air compressors, write for details. The Maxim engineering department will be glad to help you.

THE MAXIM SILENCER CO.

85 Homestead Ave. HARTFORD, Conn.

THE CAMERON MOTORPUMP-serves all industries



Cameron Motorpumps fit the liquid handling needs of so many industries that you find them everywhere.

They are furnished in a wide variety of materials for handling not only water but many corrosive and erosive liquids as well.

Outstanding features of the Motorpump are: built-in electric motor, extra large shaft and bearings, packed shaft sleeves and renewable wearing rings.

Capacities range from 5 to 1500 gals. per min., heads from 10 to 500 ft.

Ask for bulletin 7764 or let an I-R engineer discuss Motorpumps with you.

Ingersoll-Rand

Cameron Pump Division
11 BROADWAY, NEW YORK, N. Y.

New 150 POUND
DROP FORGED STEEL
GATE VALVES

Vogt
FOR BETTER VALVES

and NOW!

THE 300 POUND LINE

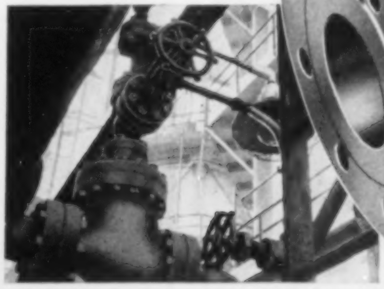
INTEGRAL FLANGED

Drop Forged Steel GATE VALVES

by Vogt

Never before has a new line of valves CLICKED so rapidly as our 150 Pound Series.

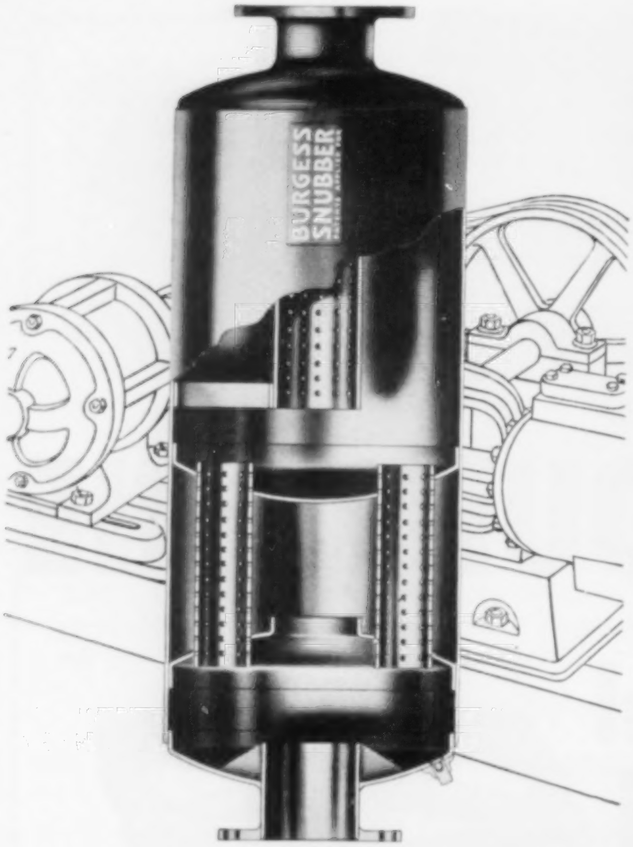
Now follows the 300 Pound line in sizes from 2" to 8", with flanges forged integral, and complying with the 300 Pound American Standard. Stainless Steel Trimmings are regularly furnished and we recommend them for steam, water, oil or gas service up to 300 pounds working pressure and temperatures to 750 deg. F.



Write for supplementary page 157-B for further details.

HENRY VOGT MACHINE CO., INC., LOUISVILLE, KENTUCKY

BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS



How to PREVENT
COMPRESSOR INTAKE NOISE

The operation of a compressor or blower results in constant fluctuations of pressure in the intake system. This pulsation of air pressure causes an objectionable "pumping" noise.

To stop these disturbing pulses, install a Burgess SDI Series Intake Snubber anywhere in the intake pipe. Its 2-stage snubber design "snubs" the slugs of incoming air and dissipates their impact energy so completely that noise is prevented. And, due to the ample dissipating surface of the perforated tubes, the Snubber offers practically no resistance to the incoming air.

Every compressor or blower manufacturer and every compressed air user is invited to send for the new bulletin on the Burgess Intake Snubber.

BURGESS
INTAKE SNUBBER

Patented and Patents Applied For

MAIL THIS COUPON FOR ILLUSTRATED BULLETIN

Burgess Battery Company, Acoustic Division
Dept. CA, 500 W. Huron Street, Chicago, Ill.

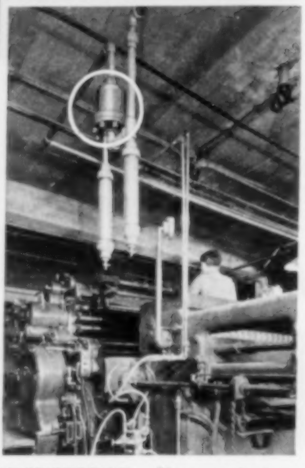
Please mail new bulletin describing Burgess Intake Snubber.

Name..

Company..

Address..

53% of Aridifier Orders are Repeats!



Rayon manufacturer ordered trial unit November, 1938; has reordered 23 to date. One of the "big three" of aircraft has reordered 16 to date; another firm several for each of nine plants.

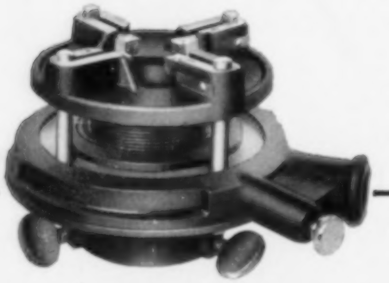
ARIDIFIERS effectively remove moisture, oil, dirt and fine scale from compressed air and gas lines by centrifugal force. Contamination impinging on the rapidly revolving vanes of the rotors (air-propelled with no appreciable back pressure), is flung to the walls and washed by collected moisture to a trap.

Maintenance and replacement of air operated tools and equipment is reduced as much as 68%, ARIDIFIERS quickly returning their cost in savings effected. Write today for details of our free trial offer, guarantee and copy of Bulletin 939.

Now made in all sizes from ⅜" to 10"—shipped from stock!

LOGAN ENGINEERING CO.
4911 Lawrence Ave., Chicago, Ill.
Offices in Principal Cities

The ARIDIFIER
Dries and Cleans Compressed Air

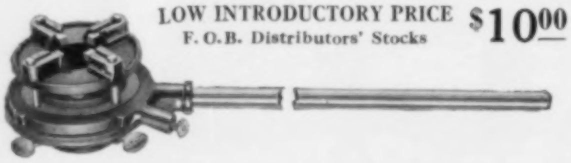


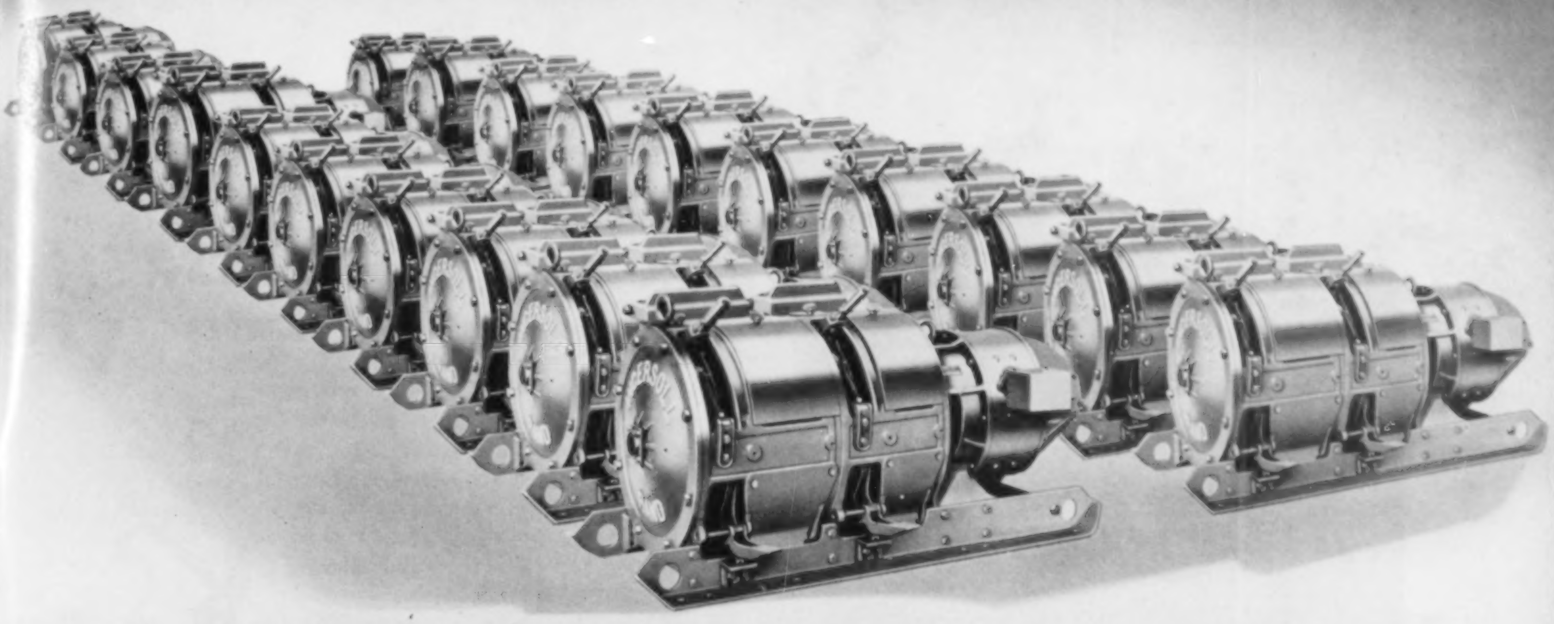
THE NEW "TOLEDO" No. 1R

— has everything to be desired in a 1" to 2" Ratchet Threader—including price. Four sets of dies—2" size made of high speed steel. Strong tubular handle 24" long. Easy to operate. "TOLEDO" easy working receding die principle. Supported die slots. Finest grade materials and workmanship. Ratchet near center of tool. Bushings for each size makes for positive, accurate centering. On sale at your local dealers.

The Toledo Pipe Threading Machine Co.
Toledo, Ohio New York Office, 72 Lafayette St.

LOW INTRODUCTORY PRICE $10.00
F. O. B. Distributors' Stocks





20 MORE "UNIT-ASSEMBLY" SCRAPER HOISTS READY FOR SHIPMENT TO ANOTHER SATISFIED CUSTOMER

A Size 2025 double-drum "Tugger" hoist pulling a hoe-type scraper to a raise in an iron mine.

A Size 30 NM-3D double-drum "Unit-Assembly" hoist mounted on an anchored car. Note size of boulders

- The excellent performance of the thousands of I-R Scraper Hoists now in service is their best recommendation. These records show *low maintenance costs, freedom from breakdowns,* and *ability to efficiently do the job they were built for.*

Let us show you what these machines have done to revolutionize mining methods and lower the cost per ton of ore or rock handled.

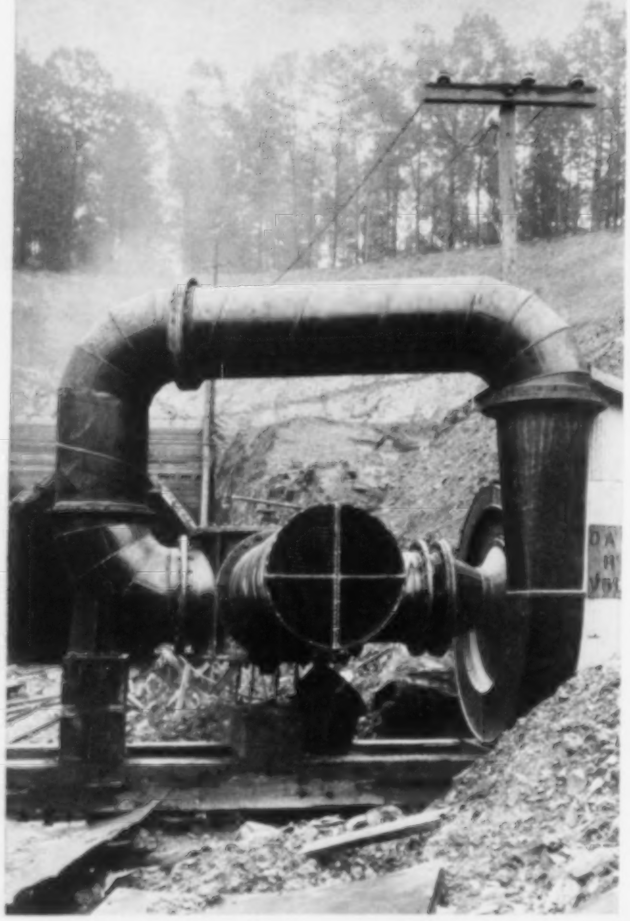
There are over 450 sizes of air, electric, and gasoline units from which to choose.

Ingersoll-Rand

11 BROADWAY, NEW YORK CITY

Atlanta
Birmingham
Boston
Buffalo
Butte
Chicago
Cincinnati
Cleveland
Dallas
Denver
Detroit
Duluth
El Paso
Hartford
Houston
Kansas City
Knoxville
Los Angeles
Newark
New Orleans
New York
Philadelphia
Picher
Pittsburgh
Pottsville
Salt Lake City
San Francisco
Scranton
Seattle
St. Louis
St. Paul
Tulsa
Washington

857-8



PIPE WORRIES END with NAYLOR

Behind this simple statement is an oft-repeated story of economy, outstanding performance and experience in fitting Naylor light-weight pipe to the most exacting specifications.

Naylor's exclusive Lockseam Spiralweld structure makes it leak-tight, flexible, stronger and safer—ideal for high or low pressure lines.

Sizes from 4" to 30" in diameter meet every requirement. All type fittings and connections. Complete fabrication service. Write for Catalog No. 37.

NAYLOR PIPE COMPANY
1245 EAST NINETY-SECOND STREET
CHICAGO, ILLINOIS

NAYLOR LOCKSEAM SPIRALWELD PIPE

WILLSON PRODUCTS

WILLSON ANNOUNCES

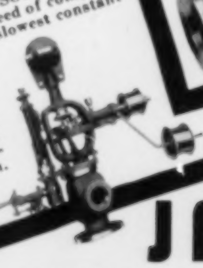
A NEW GAS MASK
for INDUSTRIAL EMERGENCIES

In emergencies involving gases or poisonous fumes, *properly designed* gas masks may mean the difference between life and death. The new WILLSON Gas Mask shown bears U. S. Bureau of Mines Approval No. 1423. It combines practical breathing comfort with proper protection. Special canisters remove or neutralize the principal industrial gases or vapors such as methyl bromide, benzol (organic vapors), chlorine, hydrocyanic acid, phosgene (acid gases) and ammonia.

New 1940 catalog now ready, write for it or obtain a copy from your nearest WILLSON Distributor.

GAS MASKS
RESPIRATORS
GOGGLES
HELMETS

DOUBLE WILLSON
PRODUCTS INCORPORATED
READING, PA., U.S.A. *Established 1870*



TIME TESTED COMPRESSOR EQUIPMENT

The basic characteristic of JARECKI FITTINGS is their uniform dependability. Air-furnace malleable fittings—heavy, close-grained, defect-free cast-iron fittings. Accurately threaded; painstakingly inspected.

JARECKI VALVES are tested far beyond their working pressure ratings—a generous BONUS of strength which assures a corresponding BONUS of service. Models and sizes to meet every condition.

ERIE UNLOADERS—Designed to maintain constant pressure by governing inlet of compressor. Load and unload without shock or strain. Precision-built to permit close regulation, smooth operation.

ERIE COMPRESSOR GOVERNOR—Governs speed of compressors to maintain slowest constant speed which will furnish required supply. Constant air pressure. The ultimate in close compressor regulation.

● 1940 marks our 88th year of service to industry. Distributors in principal cities. Full details on request.

JARECKI
MANUFACTURING CO., ERIE, PA., U. S. A.

Compressed Air Data

Just Out . . .
5th Edition

A Handbook on Pneumatic Engineering and Related Subjects

by F. W. O'Neil
Member A.S.M.E., A.I.M.E., American Mining Congress, Mining and Metallurgical Society.

125,000 COPIES IN USE!

COMPRESSED AIR DATA

408 pages, 80 illustrations. Flexible, Morocco binding, gold-edged.

This 408-page book on the theory and practice of compressed air engineering has been entirely rewritten, rearranged, and enlarged to meet today's needs of industry.

You cannot afford to be without a copy. You will find yourself referring to it daily. It has long been known as the "Bible" of the industry. It covers the subjects in which every owner and user of pneumatic equipment is interested.

The editor has avoided the formality usually associated with books of this kind. Terms, definitions, and practices are handled in a style readily understood by the non-technical reader. Numerous theories and tests are discussed and accompanied by scientific data, tables, curves, and formulae of great value to engineers and students.

Eighteen pages of cross index enable the user to quickly locate any required data.

« Price - $3.00 »

TABLE OF CONTENTS

Chapter I....Terminology and Definitions
" II....Theoretical Compression of Air
" III....Boosters and Vacuum Pumps
" IV....Turbo or Centrifugal Blowers and Compressors
" V....Tables and Data
" VI....Intake Air, Aftercooling, Intercooling, Reheating
" VII....Cost of Compressing Air
" VIII....Pumping with Air
" IX....Gas Compression
" X....Installation of Compressors
" XI....Belting
" XII....Application and Performance
" XIII....Measurement of Air Flow

Mail This Coupon to:

COMPRESSED AIR MAGAZINE CO.
942 Morris Street,
Phillipsburg, New Jersey, U. S. A.

PLEASE send me......copies of COMPRESSED AIR DATA. I inclose money order, check $........at the rate of $3 per copy postpaid. Handbooks may be returned in first-class condition within 10 days if not satisfactory.

Name..

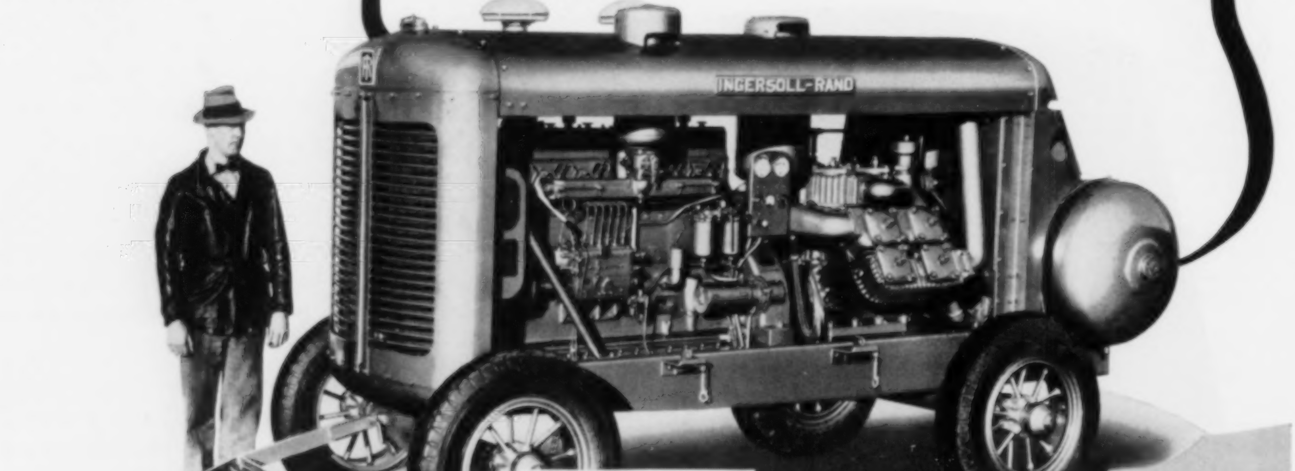
Company...

Street..

City................State.............. Country..........

Miles of Smiles
ON
TIMKEN BEARINGS

Ingersoll-Rand K-500 Two-stage Air-cooled Portable Compressor equipped with TIMKEN Bearings on the crank shaft. Delivers 500 cubic feet of free air per minute at 100 lb. pressure.



MILES OF
SMILES ON
TIMKEN BEARINGS

If you are going to buy an anti-frictionized compressor, buy one that will give you anti-friction performance *plus*. The "plus" represents additional advantages you will get if your compressor is equipped with TIMKEN Bearings. They include capacity to carry all loads—radial, thrust or both together in any combination; ability to hold vital moving parts in correct and constant alignment; TIMKEN Electric Furnace Alloy Steel, developed and manufactured by Timken to provide the greatest strength and endurance ever put in a bearing. You will be sure of getting them all by specifying "Timken Bearing Equipped"—a synonym for "Miles of Smiles".

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN

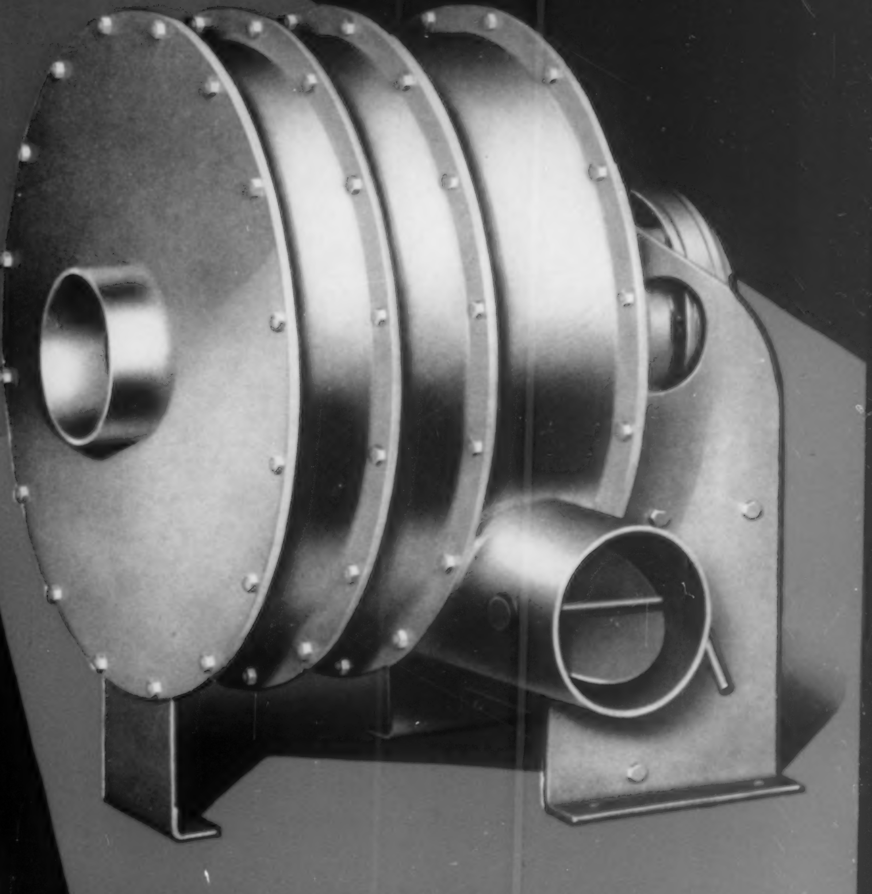
TAPERED ROLLER BEARINGS

A New BLOWER *for* OIL BURNING

Type "G"

MOTOR BLOWER

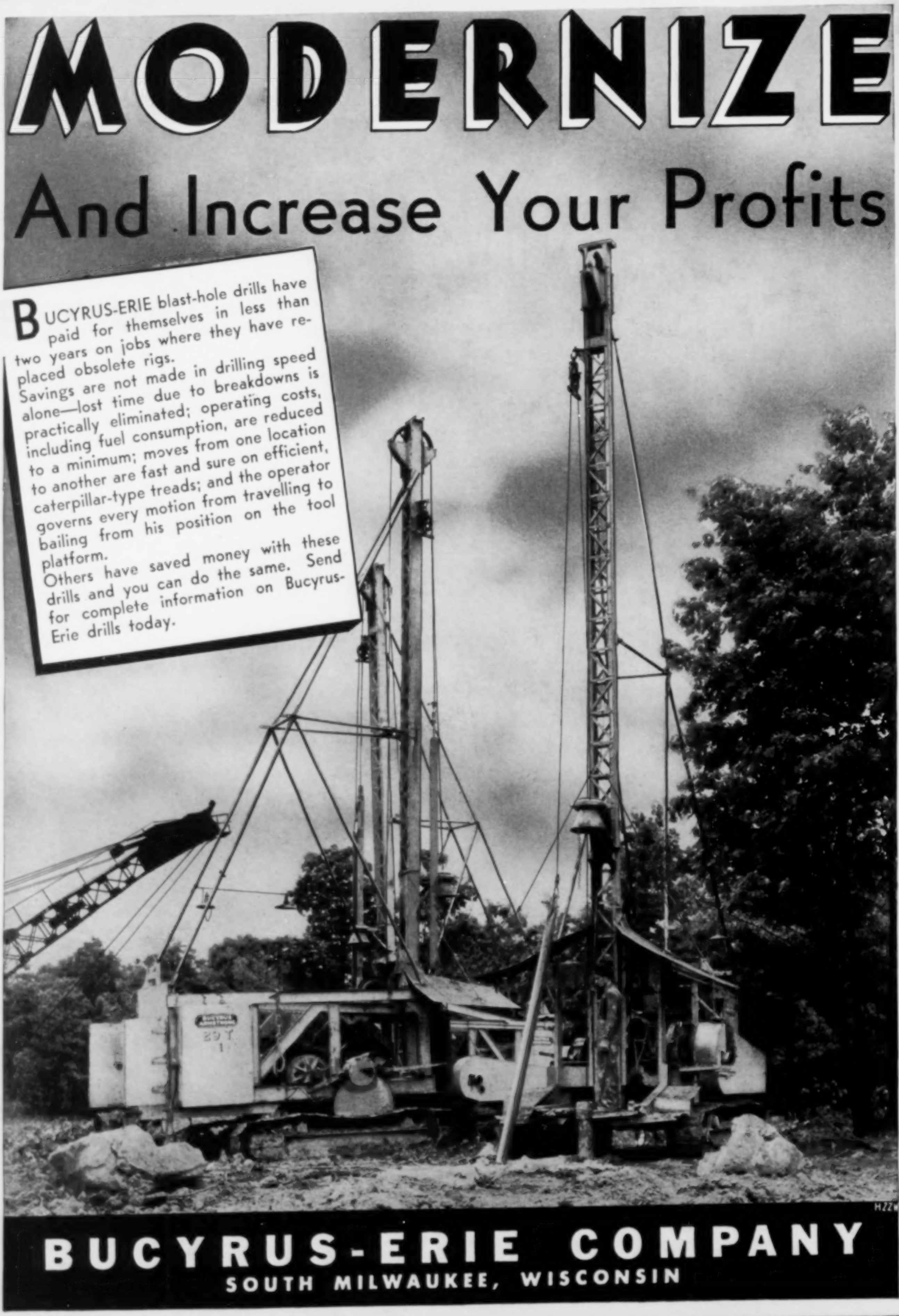
- Reliable service
- Maintains constant pressure
- Saves Power
- Complete range of sizes
  Pressures: ½ to 2¼ lbs.
  Volume: 100 to 4500 cfm



Ingersoll-Rand

11 BROADWAY, NEW YORK CITY

880-12



MODERNIZE

And Increase Your Profits

BUCYRUS-ERIE blast-hole drills have paid for themselves in less than two years on jobs where they have replaced obsolete rigs.

Savings are not made in drilling speed alone—lost time due to breakdowns is practically eliminated; operating costs, including fuel consumption, are reduced to a minimum; moves from one location to another are fast and sure on efficient, caterpillar-type treads; and the operator governs every motion from travelling to bailing from his position on the tool platform.

Others have saved money with these drills and you can do the same. Send for complete information on Bucyrus-Erie drills today.

BUCYRUS-ERIE COMPANY
SOUTH MILWAUKEE, WISCONSIN